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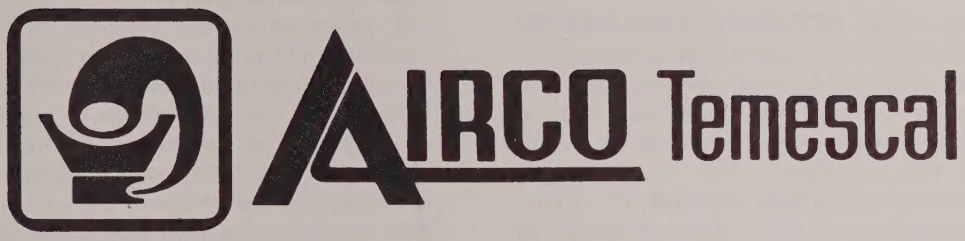

ELECTRON BEAM POWER SUPPLY
CV-8 MODELS A AND B

AIRCO TEMESCAL, A DIVISION OF AIRCO, INC.

2850 Seventh Street, Berkeley, California 94710 - Telephone: 415-841-5720, TWX: 910-366-7366

Airco Temescal
(A Division of Airco, Inc.)
2850 Seventh Street
Berkeley, California 94710

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Terms and Conditions

MECHANICAL WARRANTY: For a period of twelve (12) months from the date of original shipment to Purchaser thereof, the apparatus and each part or component manufactured by the Airco Temescal Division of Airco, Inc. ("Airco") is warranted to be free from functional defects in materials and workmanship. The foregoing warranty is subject to the condition that the apparatus, part or component be properly operated under conditions of normal use and that regular periodic maintenance and service be performed or replacements made in accordance with instructions provided by Airco. The foregoing warranty shall not apply to any apparatus, part or component that has been repaired other than by Airco or an authorized Airco representative or in accordance with written instructions provided by Airco, that has been altered by anyone other than Airco or that has been subject to improper installation or abuse, misuse, negligence, accident or corrosion.

Purchaser's sole and exclusive remedy under the above warranty is limited to, at Airco's option, repair or replacement of defective parts or components or return to Purchaser of the price of the apparatus. Any such obligation on Airco's part is subject to the following requirements: (x) the defect must be promptly reported to Airco; (y) if so advised by Airco, Purchaser must return the part or component with a statement of the observed deficiency not later than seven (7) days after the expiration date of the warranty to the address designated by Airco, during normal business hours, transportation charges prepaid; and (z) upon examination by Airco, the part or component must be found not to comply with the above warranty. Return trip transportation charges for the part or component shall be paid by Purchaser. In the event that Airco elects to refund the purchase price, the apparatus shall be the property of Airco and shall be promptly shipped to Airco at Airco's expense. This Mechanical Warranty shall be void and the apparatus shall be deemed to be purchased AS IS in the event that the entire purchase price has not been paid within thirty (30) days of original shipment of the apparatus.

THERE ARE NO EXPRESS OR IMPLIED WARRANTIES THAT EXTEND BEYOND THE WARRANTY HEREINABOVE SET FORTH. THERE IS NO WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE APPARATUS OR ANY PART OR COMPONENT THEREOF AND NO WARRANTY SHALL BE IMPLIED BY LAW.

Items not of Airco's manufacture but resold by Airco are the products of other manufacturers and their warranty, if any, shall apply. THERE ARE NO WARRANTIES OF ANY KIND ON PRODUCTS OF OTHER MANUFACTURERS RESOLD BY AIRCO, EXCEPT THE WARRANTY OF TITLE, AND NO WARRANTIES SHALL BE IMPLIED BY LAW. THERE IS NO EXPRESS OR IMPLIED WARRANTY OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO PRODUCTS OF OTHER MANUFACTURERS.

PERFORMANCE WARRANTY: Airco warrants that the apparatus will comply with the specifications set forth in the purchase order. All specifications are subject to the corrections and tolerances allowed by the NEC. If the purchase order expressly provides for factory testing to verify compliance with the specifications, the Purchaser shall be entitled to witness the testing and the results of the testing. Upon demonstration of compliance with the specifications by factory testing, Airco's liability for failure to comply with the specifications shall terminate. In the event that the purchase order does not describe a comprehensive test program for demonstration of compliance with the specifications, Airco's test program (which may incorporate extrapolation of data or test results based upon similarity of criteria established by Airco) shall be used for such purpose.

If the purchase order does not expressly provide for factory testing, compliance with the specifications shall be demonstrated by field testing which shall be conducted by Purchaser at Purchaser's expense. Airco shall have the right to: (a) witness the field testing and to verify the results of such field testing; (b) have free access to all data compiled by the Purchaser in connection with any field test; and (c) conduct its own field test at its own expense during any 14-day consecutive period which may be mutually agreed upon by Airco and the Purchaser; provided, however, that Airco shall have the right to field test within six months of receipt from the Purchaser of any notice of failure to comply with the specifications. If compliance with the specifications is to be demonstrated by field testing, the Purchaser shall conduct and complete all field testing within sixty (60) days of the original shipment of the apparatus and shall promptly notify Airco of any failure to comply with the specifications. Airco shall not be liable for any failure to comply with the specifications demonstrated by field testing unless it receives notice thereof within sixty-seven (67) days of the date of original shipment of the apparatus.

In the event that factory testing or field testing does not demonstrate compliance with the specifications, the Purchaser's sole and exclusive remedy under the above warranty is limited to, at Airco's option, repair or replacement of defective parts or components or return to the Purchaser of the purchase price of the apparatus. In the event that Airco elects to refund the purchase price, the apparatus shall be the property of Airco.

Any obligations on Airco's part under this Performance Warranty are subject to the following re-

quirements: (x) the nature of the failure of the apparatus to comply with the specifications must be promptly reported to Airco in writing; (y) if the apparatus has been delivered and field tested, the Purchaser must return the apparatus or any part or component to Airco upon its request, not later than sixty-seven (67) days after initial shipment to Purchaser, to the address designated by Airco, during normal business hours, transportation charges prepaid; and (z) upon examination and testing by Airco, the apparatus must be found not to comply with the specifications. Return trip transportation charges for the apparatus or any part or component shall be paid by the Purchaser. This Performance Warranty shall be void and the apparatus shall be deemed to be purchased AS IS in the event that the entire purchase price has not been paid within thirty (30) days of original shipment of the apparatus.

THERE ARE NO EXPRESS OR IMPLIED WARRANTIES THAT EXTEND BEYOND THE WARRANTY HEREINABOVE SET FORTH. THERE IS NO WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE APPARATUS OR ANY PART OR COMPONENT THEREOF AND NO WARRANTY SHALL BE IMPLIED BY LAW.

DISCLAIMER OF LIABILITY: IN NO EVENT SHALL AIRCO BE LIABLE FOR DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, ARISING FROM ANY SOURCE such as, but not limited to, the manufacture, use, delivery (including late delivery) or transportation of any apparatus, part or component sold to Purchaser, whether such damages are caused by Airco's negligence or otherwise. Without limiting the generality of the foregoing sentence, Airco shall not be liable for: the cost of capital; the cost of substitute apparatus, services, repairs, components or parts; loss of profit or revenue; the cost of power whether purchased or produced by the consumer thereof; loss of use of the apparatus or any part thereof, or any other property owned by Purchaser; claims or costs of Purchaser's customers; injury to persons or death; or damages to any property. In the event that any limited warranty or disclaimer of liability is found to be unlawful or inapplicable, or to have failed of its essential purpose, Airco's liability shall be limited to the amount paid by Purchaser for the apparatus.

USER RESPONSIBILITY

This equipment will perform in accordance with the instructions and information contained in this manual, and its referenced documents, when such equipment is installed, operated, and maintained in compliance with such instructions. The equipment must be checked periodically. Defective equipment shall not be used. Parts that are broken, missing, plainly worn, distorted, or contaminated, shall be replaced immediately. Should such repair or replacement become necessary, Airco recommends that a telephonic or written request for service be made to Airco Temescal.

The equipment, or any of its parts, shall not be altered without the prior written approval of Airco Temescal. The user and/or purchaser of this equipment shall have the sole responsibility for any malfunction which results from improper use, faulty maintenance, damage, improper repair or alteration by any party other than Airco Temescal.

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3E-7684C	Regulator P.C. Board Assembly
307-1304B	Transductor Amplifier P.C. Board Assembly
307-4933D	1.2A through 15A Transductor Amplifier Schematic
408-1943	Beam Sweep Control Auxiliary Power Supply P.C. Component Board Assembly
407-3173	Lateral Sweep Power Supply P.C. Board Assembly (Section 1111)
407-3863C	Longitudinal Focus P.C. Board Schematic (Section 2611)
407-3873A	Longitudinal Focus P.C. Board Assembly (Section 2611)
407-3971A	Console-Capacitor Focus P.C. Board Schematic
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408-0834B	Gun Control P.C. Card Schematic
408-0843E	Gun Control P.C. Card Assembly
409-4533C	Longitudinal and Lateral Sweep P.C. Board Schematic (Sections 2612 and 2613)
409-4563E	Longitudinal and Lateral Sweep P.C. Board Assembly (Series)
506-1604B	XYS-8 Sweeper Power Supply Schematic
506-0365C	Power Module and Control Console Schematic (208/220/240V) (2 sheets)
506-0445B	Power Module and Control Console Schematic [360/380/415V] (2 sheets)

SAFETY INSTRUCTIONS FOR OPERATING AND MAINTENANCE PERSONNEL

DANGER: HIGH VOLTAGE!!

1. Before servicing or operating this equipment, read all the component manuals supplied with the system, paying special attention to any safety precautions.

2. Before servicing this equipment, disconnect the electrical power at the main power switch. This switch should have a lock out feature. Lock the power off and keep the key with you while working on the equipment.

3. Before entering any service area, use the special grounding hook (provided) to short out all voltages from the various high voltage parts and conductors.

4. Certain electrical components (e.g. electrolytic condensers) hold a lethal voltage even after the main power is turned off. BE SURE such components have been discharged by shorting the B+ terminals to ground before starting any repairs.

5. Be sure the equipment is connected to a power receptacle having the correct polarity and grounding as prescribed by the National Electrical Code. Refer to the power supply section of the instructions to determine the proper electrical ground.

6. DO NOT TOUCH high voltage leads such as filament leads to the electron beam gun or the secondary of the filament transformers.

7. This equipment contains electrical interlocks to protect personnel from injury. DO NOT DEFEAT, OVERRIDE, OR BYPASS THESE PROTECTIVE DEVICES!! Never leave the keylock in the "SERVICE" position. This is a service only position and bypasses the safety interlock system. Normal operation requires the keylock to be in the "AUTO" or "MANUAL" position.

8. DO NOT WORK ALONE!

9. Wear safety glasses.

10. Operators shall not enter areas of the equipment intended for service access only. Only experienced service personnel should enter such areas AFTER taking the various precautions described above.

11. POST HIGH VOLTAGE WARNING SIGNS conspicuously in the operating area.

12. Remove rings, watches, and bracelets before working around high voltage.

SECTION 1

SPECIFICATIONS

1.1 INTRODUCTION

The Airco Temescal Models CV-8 A and B are direct current, constant voltage 8 kW power supplies designed to power and control one or two electron beam guns. They are compatible with sources utilizing electromagnetic deflection guns or combinations of electromagnetic and permanent magnet guns, such as the Airco Temescal SuperSource™. They deliver up to 10 kV at 0.8A to the source and also supply emission current regulated filament power. Vacuum system interlock connections are installed to provide safety for the operator and equipment. A filament transformer for each source is mounted at the vacuum tank.

All information in this manual applies to the CV-8 A and B models. In cases where there is a difference between A and B the information applicable to B only is set off by brackets, e.g. [].

1.2 HIGH POWER DISTRIBUTION

The entire 8 kW of the CV-8 A and B can be delivered to one electron beam source or be shared between two sources operating simultaneously. Any change in the operation of one source will not affect the operation of the second.

1.3 HIGH POWER REGULATION AND STABILITY

The high voltage is fully adjustable from 5 to 8 kV, and is maintained within ±2%. The emission current is independently regulated (figure 1-1) and is also withing ±2%.

The open circuit unregulated voltage of the power supply is 12.6 kV. The negative output is connected to the electron beam source or sources. The positive side is connected to ground through a triode tube which acts as a series regulator. The high power triode serves as a variable voltage device and provides good regulation. The resistance of the triode is varied by the grid control circuits so that the voltage available to the electron beam source is the voltage of the direct current supply (12.6 kV) minus the voltage drop across the triode tube. In case of a short circuit or over-current condition, all of the power is dissipated across the tube.

1.4 EMISSION REGULATION

The emission current of the electron beam source is determined by the temperature of the tungsten filament

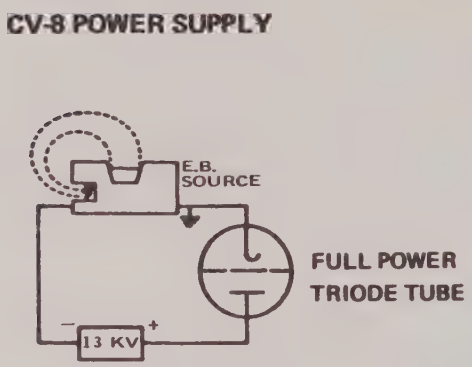


Figure 1-1. Full power triode regulation

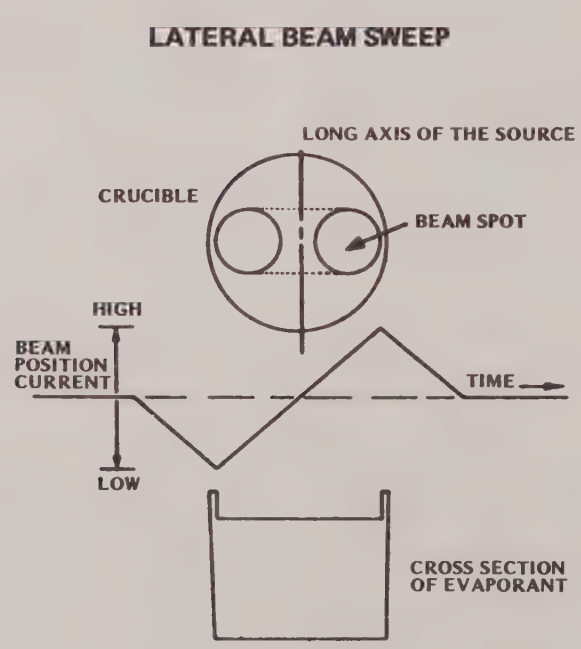


Figure 1-2. Lateral sweep effect

of the electron beam gun. Variable power for the filament comes from a silicon controlled rectifier located in the gun control. A transductor measures total emission and provides a signal for the feedback circuit that controls the rectifier. The feedback circuit maintains the current level within ±2% of the selected value.

The CV-8 A and B are designed for automatic operation by an external controller, such as a rate monitor or other device to produce a signal of ±10 volts direct current. A rate monitor measures the deposition rate on the substrates. The gun control adjusts the emitter filament temperature to maintain a constant rate until the deposition is completed. A thickness monitor senses the amount of evaporant deposited and then opens the AUXILIARY interlock in the gun control to stop the deposition.

1.5 BEAM POSITION CONTROL (STANDARD)

Electron beam sources utilize permanent magnets or electromagnets to confine the electron beam in the crucible. The beam position control provides power for the longitudinal (Y) position electromagnet. In addition, the circuit provides adjustable high and low current limits. This feature assures that the electron beam will shut off if the magnetic field is too strong or too weak to hold the beam within the crucible. These same current limits prevent the electron beam from being turned on until there is sufficient current flowing in the electromagnet.

1.6 XYS-8 SWEEP CONTROL

The XYS-8 provides full longitudinal (Y) and lateral (X) positioning for the electron beam. In addition, it also provides the programming for positioning currents to sweep the beam over the entire area of the evaporant. The amplitude and frequency of the sweep are variable and are selected by the operator from a control on the front panel.

When evaporating from a pool of molten material, it is not necessary for the beam to sweep the surface; however, certain metals and dielectrics sublime instead of passing through a liquid phase. In this case, if the beam remains in one place very long, it creates a crater which deepens and collimates the stream of evaporant, causing non-uniform distribution and minimal bulk evaporation.

For this reason, electron beam sources are equipped with electromagnets which position the beam in both the longitudinal and lateral axes. By changing the current in either one of the electromagnet coils, the beam will

traverse a straight line. The amplitude of the traverse is determined by the maximum and minimum currents delivered to the elctromagnet. If the current is changed in both coils simultaneously, the beam can be made to sweep over the entire area of the evaporant. When properly programmed, a uniform distribution on the substrate is obtained.

Because the XYS-8 sweep operates with a triangular waveform (figure 1-2), the current in the focusing coil moves from a minimum to a maximum at a constant rate. As a result, the electron beam spends equal amounts of time at all points along its traverse line. If a beam sweep is employed for only one coil, the beam will erode a flat depression in the evaporant. When the beam sweep is activated for both coils, the entire surface of the evaporant is uniformly eroded.

1.7 HIGH VOLTAGE POWER SUPPLY, INTERLOCKS AND PANEL LIGHTS

a) POWER ON Light: Indicates the MAIN POWER CIRCUIT BREAKER is closed and the line voltage is applied to the control transformer.
b) AIR Flow Interlock: Ensures the presence of cooling air for the voltage regulator triode tube. The panel light glows when the blower is delivering sufficient air as indicated by an air flow switch.
c) DOORS Interlock: When all three power supply module doors (two side, and one back) are closed, the light glows. The doors are equipped with microswitches in series.
d) VAC TANK Interlock: Ensures that the chamber is closed prior to the application of high voltage (see section 2.3).
e) VAC GAUGE Interlock: Ensures that the system pressure is below 1×10^{-3} torr. Nearly all ion gauge control units are equipped with a switch that closes when the ion gauge filament is turned on and stays on.
f) P.C. CARDS & KEY LOCK Switch: Prevents operation by unauthorized personnel. Insertion and rotation of the key closes the switch. The key cannot be removed without opening the high voltage circuit.
g) H.V. OFF Switch: When all interlocks are satisfied, the white H.V. OFF switch illuminates. This indicates that the operator may turn on the high voltage when he is ready.
h) H.V. ON Switch: This normally-open switch provides momentary current for a pull-in relay which completes the circuit. The switch is red when illuminated.
i) AUXILIARY Interlock: A spare interlock is provided for customer use.
j) GUN WATER interlock: Ensures the presence of sufficient water for the electron beam source.

k) GUN FOCUS Interlock: Ensures that suffcient current is flowing in the electromagnetic coils to position the beam in the crucible. The BEAM POSITION control has a switch that closes when adequate current is flowing in the longitudinal position coil.
l) FIL. OFF Switch: When all the interlocks have been satisfied, the white FIL. OFF switch illuminates. This light indicates that the filament power can be turned on.
m) FIL. ON Switch: This normally-open (red when illuminated) switch provides momentary current for a pull-in relay which completes the circuit for filament power. When the operator is ready to deposit, he must increase the filament power by adjusting the EMISSION CONTROL knob.

1.8 WEIGHT

The total system weight is approximately 650 pounds. The weight varies depending on the model and specified options.

1.9 DIMENSIONS (INCHES)

a) Power supply module 28-1/2 W x 31-1/2 H (including casters) x 30-1/2 D
b) Control:
   1) Standard rack mount: 19 W x 8-3/4 H x 17 D
   2) With enclosure: 19-1/4 W x 9 H x 18-1/4 D
c) XYS-8 (optional): Standard rack mount 19 W x 3-1/2 H x 16 D

1.10 ELECTRICAL SPECIFICATIONS

1.10.1 In-put Power

208/220/230V rms [360/380/415V rms], 50/60 hertz, 3 phase, ±5% 5 wire system.

1.10.2 Electrical Outputs

a) Outputs to Electron Gun
   1) Gun potential (adjustable): -5 to -10 kV dc
   2) Gun potential regulation: ±2%
   3) Total beam current (maximum): 0.8A dc
   4) Beam current regulation: ±2%
   5) Gun filament primary power (maximum, each gun): 120V ac, 5A
   6) Gun filament power (maximum, each gun): 6V ac, 70A
   7) Longitudinal magnet current (adjustable, each gun): 0 to 3A dc into 5Ω load
   8) Magnet sweep current (optional), adjustable:
      A) Lateral: -3 to +3A dc into 5Ω load
      B) Longitudinal: 0 to -3A dc into 5Ω load
   9) Magnet sweep frequency (optional): 15 to 120 Hz in ten steps

b) Auxiliary Output
   1) 120V ac for high voltage warning lights

1.10.3 Control Input

a) 0 to +10V dc signal input from external rate monitor. The polarity may be either positive or negative, depending on internal connections. This signal must be referenced to earth ground.

1.11 CABLES

	Standard Length (Feet)
a) Input power cable	20
b) High voltage cable (connects the power supply module to the vacuum system)	20
c) Control cable(s) (connects the power supply module to the vacuum system)	20
d) Control cable (connects the power supply module to the control module)	20
e) Control cable(s) (connects the XYS-8 to the control console)	1
f) Control cable (connects the XYS-8 to the vacuum system)	20

NOTE

Cables a, b, and f may be ordered in any length. Cables c, d, and e may be ordered in various lengths but the combined length should not exceed 60 feet.

1.12 SUPPORT FACILITIES

1.12.1 Cooling Air

Input air temperature should be 0 to 40°C (32 to 104°F). The air should be as dry and clean as possible.

SECTION 2

INSTALLATION

The CV-8 A and B Power Supplies consist of the control module and the power supply module. All connections to the vacuum tank are from the power supply module (see paragraph 1.11).

2.1 MECHANICAL

2.1.1 Interlock Cable Terminal Strip

Mount the terminal strip(s) of the interlock cable and the XYS-8 cable (if used) close to the vacuum tank. The interlock cable terminals carry 120V alternating current and should be covered to protect operating personnel.

2.2 EXTERNAL INTERLOCK INSTALLATION

WARNING

All statements regarding operator and equipment safety are void if the external interlocks are not installed.

2.2.1 Vacuum Tank Interlock

Install series-connected, normally-open switches on the doors and on the main structure of the vacuum chamber or the bell jar. These switches should be placed so that they are closed only when the doors of the chamber are shut. There should be no possible access to high voltage.

2.2.2 Auxiliary Interlock

An auxiliary interlock can be installed if required. If this interlock connection is not used, the points must be jumpered to complete the interlock string.

2.2.3 Gun Water Flow Interlock

Install a water-flow switch in the return line of the electron beam gun cooling water system. The switch should close when the water flow is sufficient to cool the crucible.

2.2.4 Filament Transformer(s)

The filament transformer(s) supplied as part of the CV-8 A and B should be securely mounted to the vacuum tank as close as possible to the high voltage feedthroughs. (Refer to paragraph 2.3.4 for additional mounting details.)

2.3 ELECTRICAL CONNECTIONS

2.3.1 System Ground

Electrical grounding is an important aspect of the safe installation of electron beam equipment. The following procedure is recommended to ensure a good ground.

2.3.2 Vacuum Tank Ground (Figure 2-1)

a) The vacuum tank should be connected to a good earth ground. Under normal conditions, a good earth ground will consist of two 3/4-inch-diameter by 8-foot copper rods driven through the floor and into the earth near the tank location. Connect the ground rods to the vacuum tank by a copper wire or strap in accordance with the table in figure 2-1. Do not use braided wire. Make the connection to bare, clean, tank metal. The rods should be approximately six feet apart. Measure the resistance between the two rods using an accurate resistance bridge. Add salt water or copper sulfate to the earth to lower the resistance to 1 ohm. When this step is completed, bond the two rods together with six-gauge copper wire.

b) If the equipment is installed on the upper floors of a building, the system can be grounded by connecting the vacuum tank to the steel structure of the building. This should be done only after ascertaining that the structure has a good earth ground. If it does not, a sufficient number of rods must be driven into the ground and connected to the steel structure to ensure a suitable ground.

c) Do not rely upon the water pipes for the system ground connection. The multiple joints and associated tape and/or sealing compounds make it unwise to rely on water pipes for adequate ground. The ground must have a low impedance to radio frequency as well as to direct current. Therefore, install the grounding system in compliance with established high frequency practices.

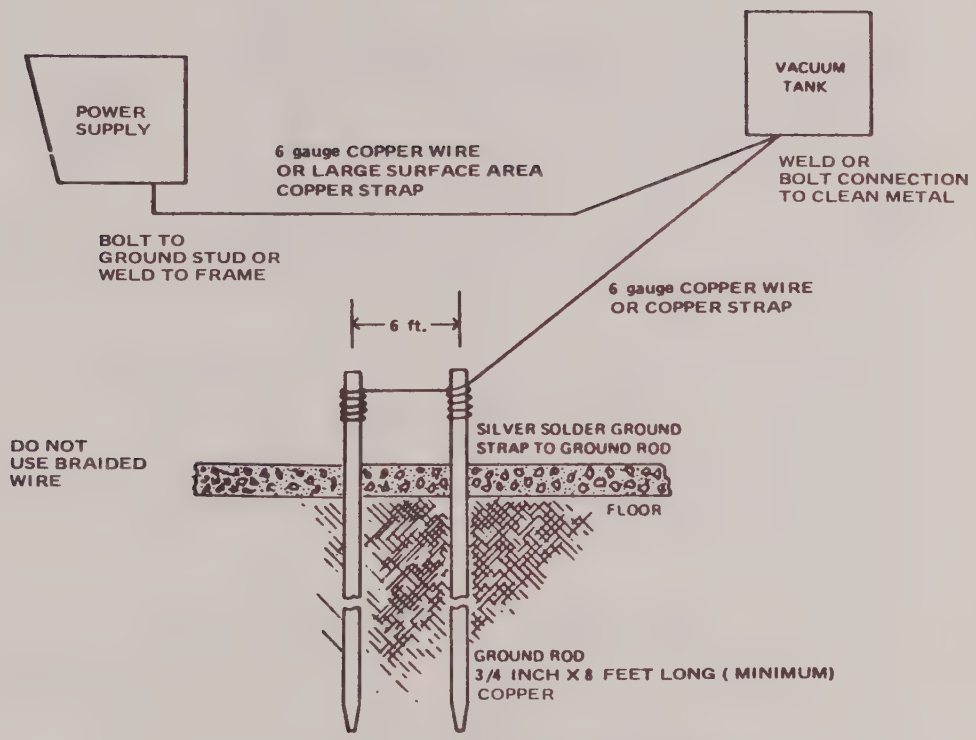
2.3.3 Gun Ground

To ground the gun to the vacuum tank:

a) Thoroughly clean the base of the electron beam source.

b) Make certain that the gun support structure is clean and free of evaporated material and is made out of non-magnetic metal.

c) Bolt the source to the support structure and then bolt the support structure to the baseplate. This satisfies the required gun-to-ground connection.


POWER SUPPLY
VACUUM TANK
6 gauge COPPER WIRE OR LARGE SURFACE AREA COPPER STRAP
WELD OR BOLT CONNECTION TO CLEAN METAL
BOLT TO GROUND STUD OR WELD TO FRAME
6 gauge COPPER WIRE OR COPPER STRAP
6 ft.
SILVER SOLDER GROUND STRAP TO GROUND ROD
DO NOT USE BRAIDED WIRE
FLOOR
GROUND ROD 3/4 INCH X 8 FEET LONG (MINIMUM) COPPER

GROUND ROD DISTANCE TO TANK (FEET)	GROUND CONDUCTOR SIZE
0-10	6 GAUGE COPPER WIRE
10-20	4 GAUGE COPPER WIRE
20-60	2 X .035 inch COPPER STRAP
60 PLUS	Consult Airco Temescal

Figure 2-1. Ground system installation

2.3.4 Filament Transformer (Figures 2-2 and 2-3)
The mounting base of the filament transformer must be connected to tank ground. Remove the paint from a small area around the mounting holes in the transformer and from the structure to which it is to be mounted. Make the connection by the mounting bolts. This ensures that the transformer core and ground shield do not rise above ground potential during operation.

2.3.5 Power Supply and High Voltage Shield Termination
Under certain conditions, radio frequency energy is generated within the tank and transmitted to the power supply through the high voltage and ground cables. It is important that the ground return cable presents a low impedance to radio frequency energy. Inductance rather than resistance is the critical parameter. This low impedance ground return should be as short as possible and should not be coiled.

Connect one end of the No. 6 gauge ground lead to the same point on the tank to which the earth ground is connected. Connect the other end of this cable to the low impedance ground stud at the lower rear of the power supply cabinet. The outer shield of the high voltage cable should also be connected to tank ground as shown in figures 2-3 and 2-3).

2.4 UTILITY POWER
Verify that the voltage on the equipment nameplate corresponds to the line power. If it does not, refer to paragraph 6.1.1 for the voltage changeover procedure.

Connect the stripped ends of the power cable to a service capable of supplying 50A.

2.5 VACUUM TANK/ELECTRON BEAM GUN WIRING

2.5.1 Gun Filament Conductors (Figures 2-2 and 2-3)
The gun filament conductors from the filament transformer to the vacuum tank feedthroughs should be as short as possible and capable of carrying 70A. Use 1/4-inch-diameter copper rod. The conductors should be insulated for 20 kV and should be suspended by their ends. Since these wires carry a lethal voltage, install a protective barrier to prevent accidental contact. The vacuum tank feedthroughs should be rated for a minimum of 70A and 12 kV.

The gun filament conductors from the feedthroughs to the electron beam gun filament terminals should be capable of carrying 70A. Use 1/4-inch-diameter copper (not insulated) rod.

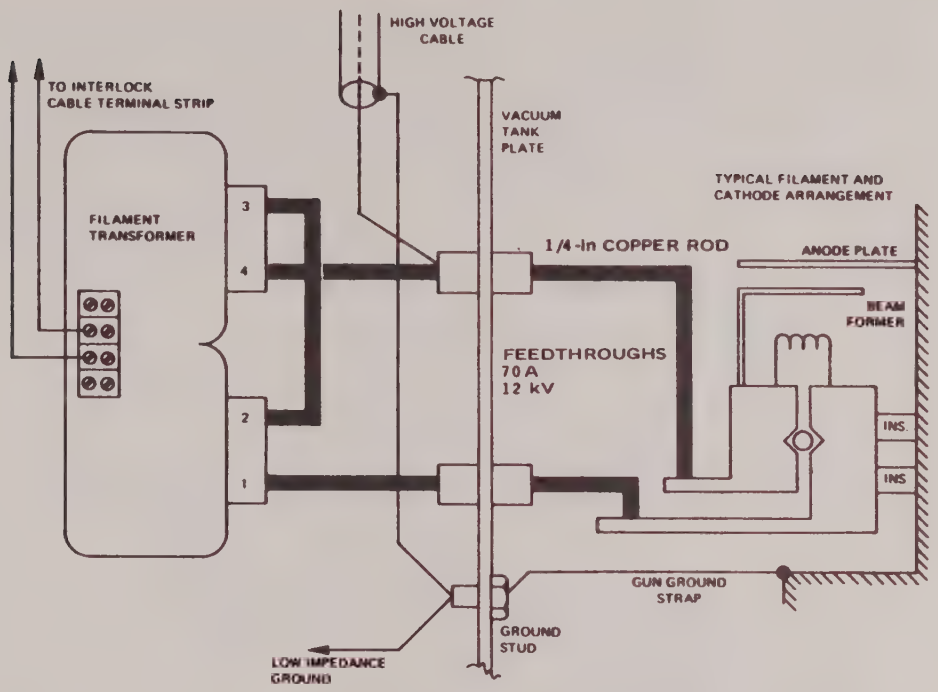


Figure 2-2. Filament transformer connection diagram, 840 VA

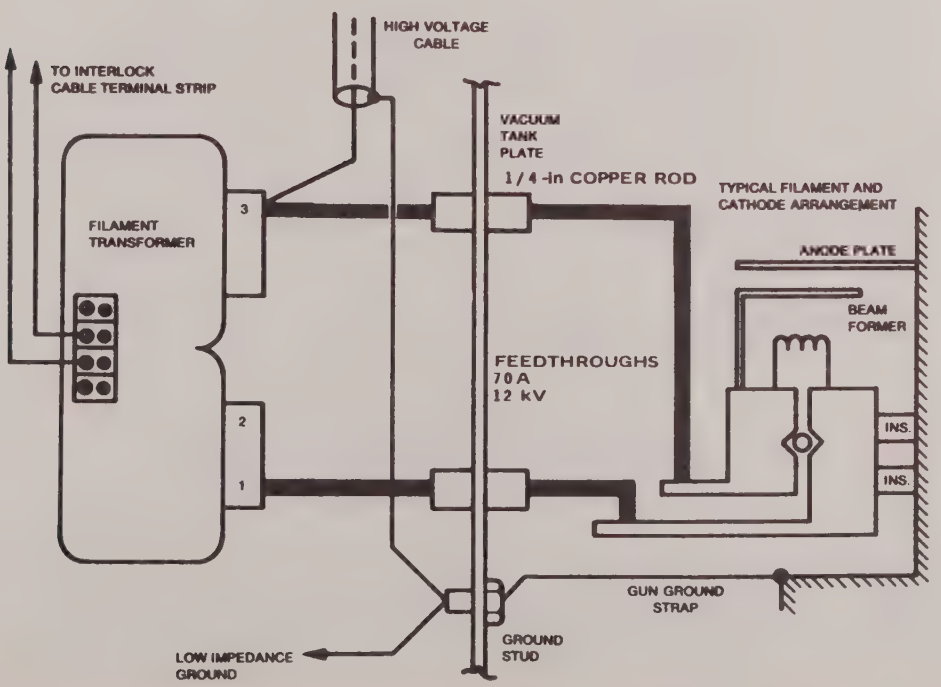


Figure 2-3. Filament transformer connection diagram, 420 VA

All filament wire connections must be clean and tight.

2.5.2 Focus Coil Connections
All connections between the focus coil terminals on the electron beam gun and the vacuum tank feedthrough should be made with No. 16 gauge (minimum) copper wire. The wire should have high temperature insulation. In most installations, glass jacketed, silicon-rubber insulated wire is adequate. These wires should be placed well away from the filament wires and should be shielded by a ground plane.

2.6 POWER SUPPLY TO VACUUM TANK CONNECTION

2.6.1 High Voltage Coaxial Cables (one for each gun)
Connect the coaxial cable center conductor to the filament transformer feedthrough at the end of the secondary winding that is connected to the electron gun cathode structure or the beam former electrode.

CAUTION
Do not use the center tap of the transformer for the high voltage connection. Damage to the transformer might result.

Connect the outer conductor (shield) to the tank baseplate (earth ground). Route the high voltage cable through the 2-inch-bushing at the lower rear of the power supply module. Then connect the center conductor to the appropriate terminal on the high voltage rectifier panel. Use terminal E11 for gun No. 1, and E12 for gun No. 2.

Connect the outer conductor (shield) to any convenient terminal on the central ground point terminal (CGP).

2.7 INTERLOCK CABLE (Figure 2-4)

2.7.1 Installation
The interlock cable carries all interlock signals in addition to focus power and auxiliary output terminations.

WARNING
ALL STATEMENTS REGARDING OPERATOR AND EQUIPMENT SAFETY ARE VOID IF THE EXTERNAL INTERLOCKS ARE BYPASSED.

Connect the cable to J2 (labelled TANK) on the service panel at the lower rear of the power supply module. Connect to the terminal strip on the vacuum tank as follows:

2.7.2 High Voltage Interlocks

a) VAC TANK: Connect all access panel microswitches, hoist limit switches, or access door microswitches in series between terminals 1 and 2.
b) Connect the ion gauge or VAC GAUGE interlock between terminals 2 and 3.

2.7.3 Gun Interlocks

a) Connect the AUXILIARY interlock for gun No. 1 between terminals 4 and 5. (The AUXILIARY interlock may be used with a thickness monitor or water temperature switch.) If no AUXILIARY interlock is required, jumper terminals 4 and 5.

WARNING

Do not connect any high voltage interlocks such as the access panel microswitches, hoist limit switch, etc., between terminals 4 and 5. Connect them in series and only between terminals 1 and 2.

b) Connect the normally-open contacts of the gun No. 1 water flow switch between terminals 5 and 6.
c) Connect the AUXILIARY interlock for gun No. 2 between terminals 7 and 8.

NOTE

If no AUXILIARY interlock is required, jumper terminals 7 and 8.

d) Connect the normally-open contacts of the gun No. 2 water flow switch between terminals 8 and 9.
e) Connect terminals 10 and 11 to the gun No. 1 filament transformer primary. Use at least No. 16 gauge wire.
f) Connect terminal 12 to the minus side of the No. 1 gun (longitudinal) focus coil. Connect terminal 13 to the plus side of the No. 1 gun (longitudinal) focus coil.

NOTE

If an XYS-8 is used, see paragraph 2.8 before connecting the focus coil.

g) Connect terminals 14 and 15 to the No. 2 gun filament transformer primary. Use at least No. 16 gauge wire.
h) Connect terminal 16 to the minus side of the No. 2 gun (longitudinal) focus coil. Connect terminal 17 to the plus side of the No. 2 gun (logitudinal) focus coil.

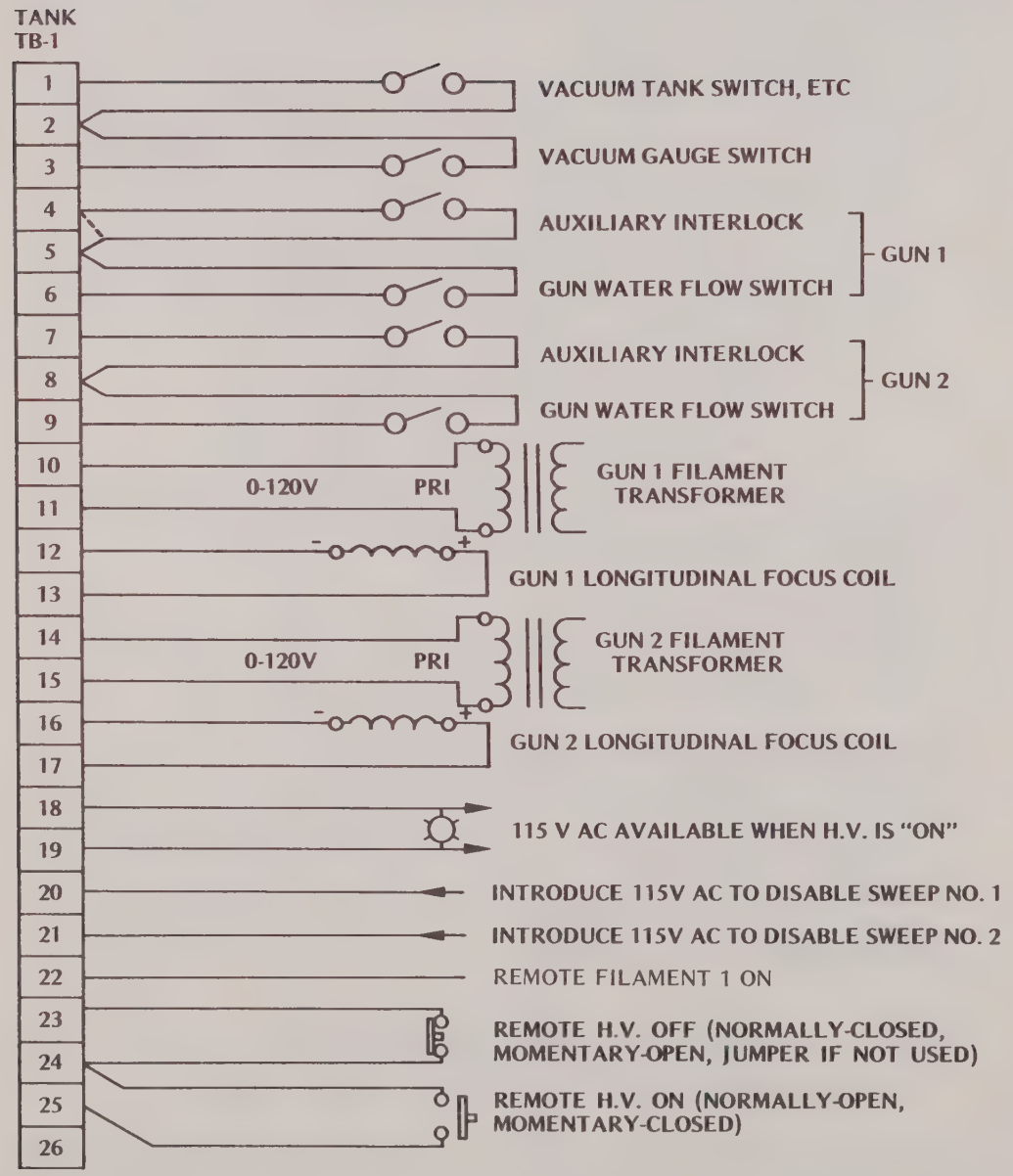


Figure 2-4. CV-8 A and B interlock terminal strip connection diagram

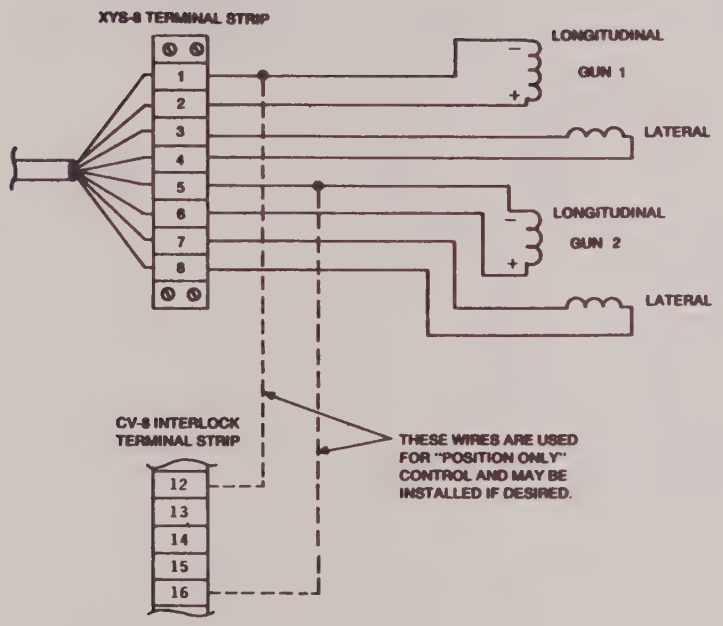


Figure 2-5. XYS-8 terminal strip connection diagram for CV-8 A and B

i) Terminals 18 and 19 provide 120V alternating current when high voltage is on. A warning light may be connected if desired.
j) Introducing a 115V alternating current on terminal 20 will turn the XYS-8-1 lateral and longitudinal sweep to zero (no sweeping action).
k) Introducing a 115V alternating current on terminal 21 will turn the XYS-8-2 lateral and longitudinal sweep to zero (no sweeping action).
l) Terminal 22 is the neutral return of the 115V alternating current introduced on terminals 20 and 21.
m) Normally-closed, momentary open switch, when wired to terminals 23 and 24, will provide a remote H.V. OFF control. Jumper terminals 23 and 24 together if a remote H.V. OFF control is not desired.
n) Normally-open, momentary closed switch, when wired to terminals 24 and 25, will provide a remote H.V. ON control.

2.8 XYS-8 CABLE (Figure 2-5)

Connect the cable to the XYS-8 jack on the service panel of the power supply. Wire the terminal strip to the end of the vacuum tank as follows:

a) Connect the minus side of the No. 1 gun (longitudinal) focus coil to terminal 1. Connect the plus side to terminal 2.
b) Connect the No. 1 gun (lateral) focus coil between terminals 3 and 4.
c) Connect the minus side of the No. 2 gun (longitudinal) focus coil to terminal 5. Connect the plus side to terminal No. 6.
d) Connect the No. 2 gun (lateral) focus coil between terminals 7 and 8.

2.9 RATE MONITOR INPUT (Figure 2-6)

WARNING

Refer to the rate monitor manual to be sure that the common can be grounded without damage to the instrument. Also determine if the output is positive or negative.

Remove the gun control printed circuit board (Figure 6-3) and check the jumper. If the rate monitor output is positive, the jumper should be between holes 1 and 3, and if negative, between 1 and 2. Replace the board in its socket. Connect the rate monitor output to the appropriate BNC jack on the rear of the control module.

2.10 INTERCONNECTION CABLES

Connect the cables between the power supply module and the control module. One cable is supplied for each gun installation and one for the control cable. If an XYS-8 is used, connect the cable between the XYS-8 and the control module.

2.11 GROUNDING HOOKS

Keep grounding hooks near the vacuum tank.

IMPORTANT

Refer to section 3 for initial turn-on instructions.

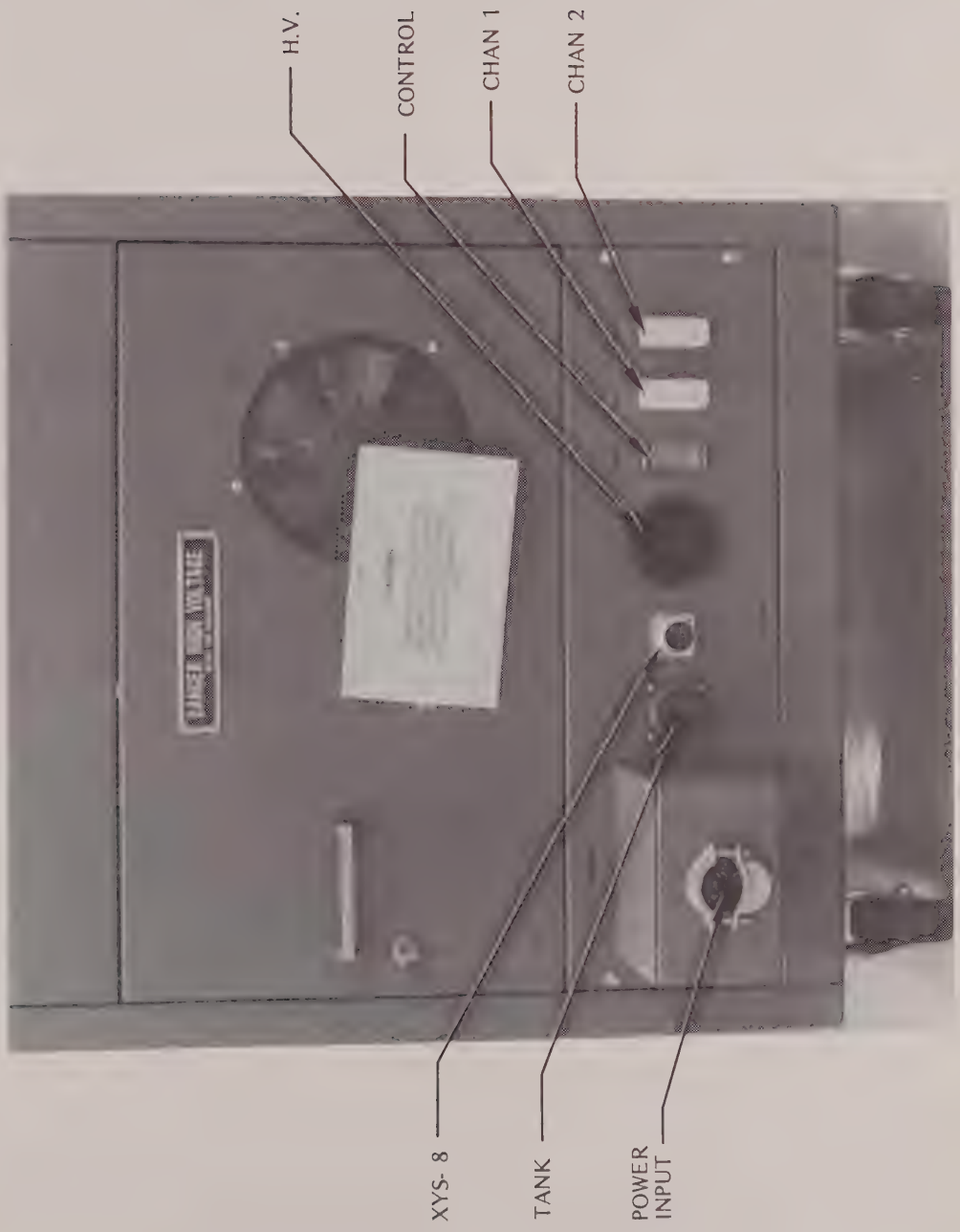


Figure 2-6. CV-8 A and B power supply (rear view).

SECTION 3

FRONT PANEL CONTROLS AND INDICATORS

See Figures 3-1 and 3-4

3.1 POWER SUPPLY MODULE

The MAIN POWER CIRCUIT BREAKER (CB1) on this panel is a resettable, 50A [35A] circuit breaker for main power protection and is also used as a master ON/OFF control.

3.2 CONTROL MODULE

3.2.1 High Voltage Control Panel (Figure 3-1)

a) POWER ON indicator (LT1): lights when power is applied to the power supply through the main power circuit breaker.
b) AIR indicator (LT2): lights if sufficient air flow is supplied to the power triode cooling circuit.
c) DOORS indicator (LT3): lights if the power supply module side panels and rear access door are closed.
d) VAC TANK indicator (LT4): lights if the customer-installed switch on the vacuum tank is closed.
e) VAC GAUGE indicator (LT5): lights if the customer-supplied vacuum gauge switch is closed.
f) P.C. CARDS & KEY LOCK indicator (LT6): lights if all power supply printed circuit boards are correctly installed and if the key lock switch is turned ON.
g) Key lock (SW1): a key-operated switch which enables the high voltage control circuits.
h) H.V. ON (PB2): red, momentary-contact pushbutton switch which applies power to the high voltage power supply contactors and latching circuits. The internal lamp is illuminated when the switch is closed and remains on as long as power is applied to the high voltage power supply.
i) H.V. OFF (PB1): white, momentary-action pushbutton switch which opens the high voltage latching circuit and causes the input power to be removed from the high voltage power supply. The internal lamp is illuminated when the high voltage is off and all high voltage control interlocks are closed. This is used as a READY indicator.
j) High Voltage Meter (ME1): indicates voltage available to electron beam guns (15 kV full scale).

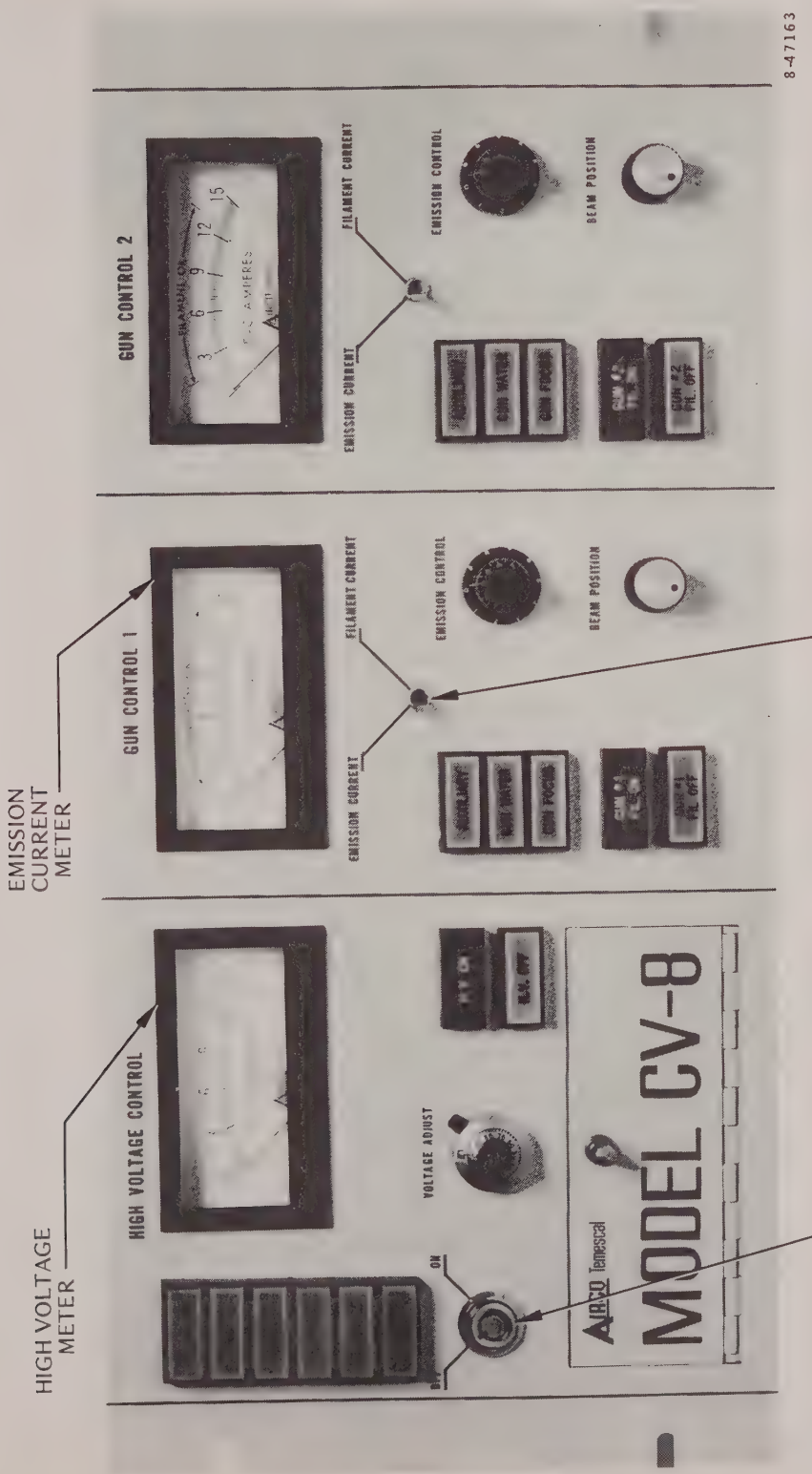


Figure 3-1. CV-8 A and B control module, front panel controls and indicators

k) VOLTAGE ADJUST (R1): clockwise rotation increases the high voltage. Nominal operating range is from 5 to 10.2 kV.

3.2.2 Gun Control Panel (Figure 3-1)

a) AUXILIARY indicator (LT7): lights if the customer-supplied auxiliary interlock is closed.
b) GUN WATER indicator (LT8): lights if the customer-supplied water flow switch in the gun cooling water line is closed.
c) GUN FOCUS indicator (LT9): lights if the longitudinal focus current is within the desired limits. This lamp will light automatically if a permanent magnet source (SuperSource™) is used.
d) FIL. ON (PB4): red, momentary-contact pushbutton switch that applies power to the filament and latching circuits. The internal lamp is illuminated when the switch is closed and remains lighted as long as power is applied to the filament.
e) FIL. OFF (PB3): white, momentary-action pushbutton switch that opens the filament control latching circuits and causes power to be removed from the gun filament. The internal lamp is illuminated when the filament power is off and all filament control interlocks are closed. This functions as a READY indicator.
f) Meter switch (SW4): spring-return toggle switch that selects either EMISSION CURRENT or FILAMENT CURRENT readings on the emission current meter.
g) Emission Current Meter (ME2): indicates gun emission current (1.5A full scale) or relative filament current.
h) EMISSION CONTROL (R6): clockwise rotation increases the emission current. Nominal operating range is from 0 to 0.8A.
i) BEAM POSITION control (R10): clockwise rotation increases the focus current and moves the beam closer to the filament. This control is disconnected when the NORMAL-XYS-8 switch is in the XYS-8 position.

3.2.3 XYS-8 Controls (Optional) Figures 3-2 and 3-3)

a) LONGitudinal FREQUENCY (S1): a ten-position thumbwheel switch. The frequency increases as the number setting is increased. The nominal range is 15 to 100 Hz in ten steps. Position zero provides maximum sweep frequency.
b) Longitudinal BEAM POSITION (R1): clockwise rotation increases the average longitudinal focus current and moves the beam closer to the filament. This control moves the beam on an axis through the gun filament centerline.

8-46936

Figure 3-2. XYS-8 front panel controls

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Figure 3-3. XYS-8 rear panel controls

c) Longitudinal SWEEP (R4): clockwise rotation increases longitudinal sweep amplitude; zero is the maximum frequency.
d) BEAM POSITION CURRENT meter (ME1): indicates either longitudinal or lateral average focus current (-3 to 0 to +3).
e) BEAM POSITION CURRENT meter switch (SW3): this toggle switch selects either LONGitudinal or LATeral current readings on the BEAM POSITION CURRENT meter.
f) LATeral FREQUENCY switch (S2): a ten-position thumbwheel switch. The frequency increases as the number setting is increased. The normal range is 15 to 100 Hz in ten steps. Position zero is the maximum sweep frequency.
g) Lateral BEAM POSITION (R5): adjusts the beam position in the lateral (X) direction by changing the average lateral focus current.
h) Lateral SWEEP (R6): clockwise rotation increases the lateral sweep amplitude.

3.2.4 Circuit Breaker Panel (Figure 3-4)

a) Local/REMOTE switches (SW3 for gun No. 1, and SW6 for gun No. 2): two toggle switches (one for each gun) that select the desired emission control mode. The LOCAL (up) position connects the EMISSION CONTROL to the electron gun circuitry; the REMOTE (down) position connects external input (usually from a customer-supplied rate monitor) to the gun control circuits.
b) NORMAL-SS switches (SW2 for gun No. 1 and SW5 for gun No. 2): the NORMAL (up) position is for control of the guns utilizing only the electromagnetic fields for focus. The SS (down) position is for control of the guns utilizing the permanent magnet main field and electromagnetic beam position control (Airco Temescal's new SuperSource.) This position bypasses the focus interlock.
c) Circuit breakers: circuit breakers one through ten protect the various circuits in the power supply. They are located in the panel behind the hinged door. When tripped they protrude about one half inch from the case. To reset, push the tripped indicator button.

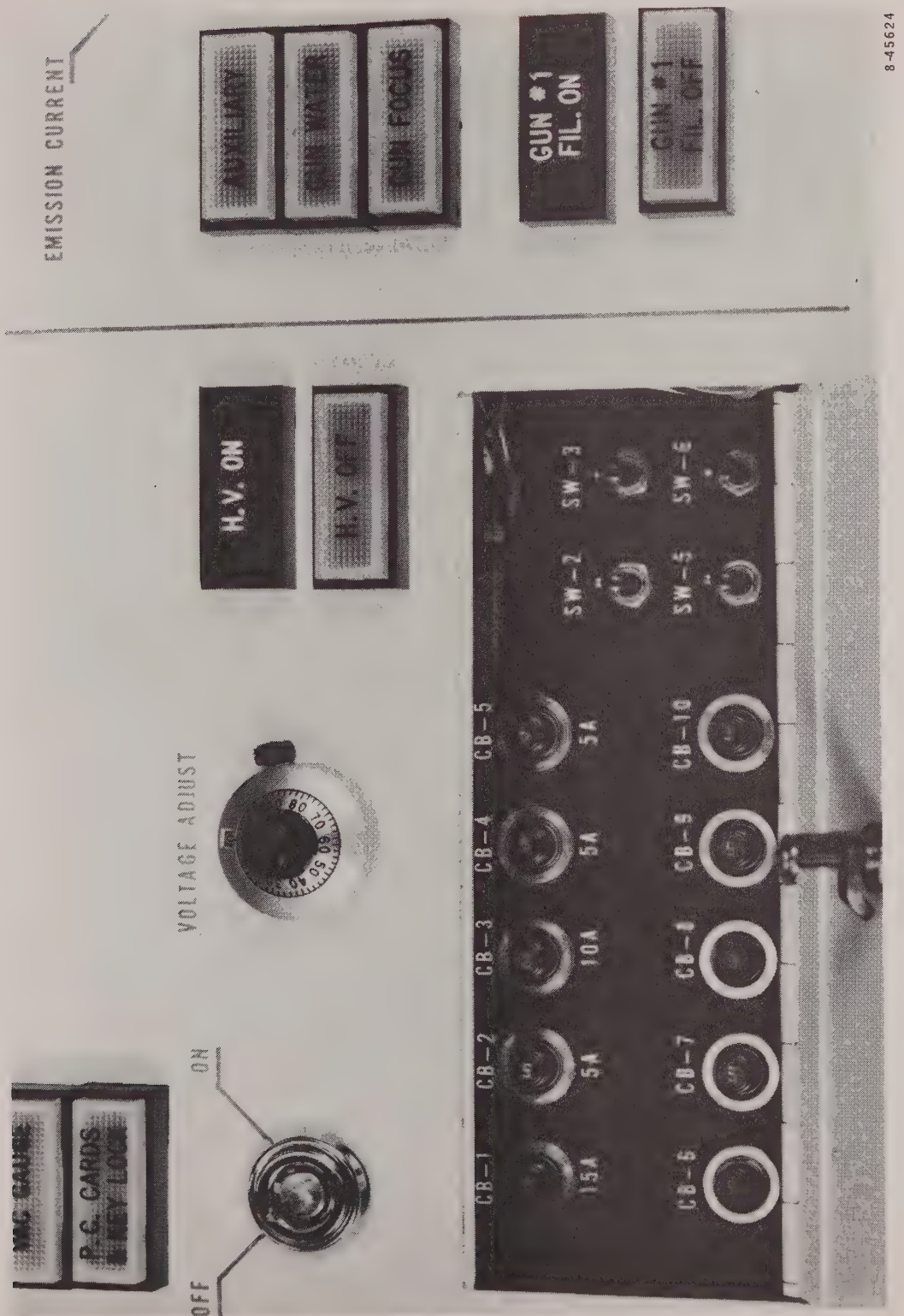


Figure 3-4. CV-8 A and B control module circuit breaker panel controls

Circuit Breaker	Amperes	Function
CB1	15	Control power on
CB2	5	XYS-8 No. 2 and interlocks
CB3	10	Regulator tube filament and fan power
CB4	5	Bias power and XYS-8 No. 1
CB5	5	Electron gun control No. 1
CB6	5	Electron gun control No. 2
CB7	5	Channel No. 1 filament primary
CB8	3	Channel No. 1 longitudinal focus output
CB9	5	Channel No. 2 filament primary
CB10	3	Channel No. 2 longitudinal focus output

3.3 AUXILIARY CONTROLS

a) SCR bias control: a 20-turn potentiometer sets the minimum filament current (figure 6-3).

b) Rate range control: a 20-turn trimmer potentiometer located next to the SCR bias control. This control adjusts the maximum rate monitor input signal level (figure 6-3).

c) Power supply module circuit breakers: two resettable circuit breakers located behind the front panel of the power supply, below and to the right of the main power circuit breaker. The 40A [25A] unit provides overload protection for the high voltage circuits. The 5A unit provides overload protection for the longitudinal beam position and gun control power supplies (figure 3-5).

d) NORMAL-XYS-8 switch: located on the rear panel of the control module, this toggle switch provides for longitudinal beam position control with no sweep or, if an XYS-8 is used, for full sweep control (figure 3-6).

e) XYS-8 circuit breakers (optional): resettable pushbutton circuit breakers located on the rear panel of the XYS-8 (figure 3-3).

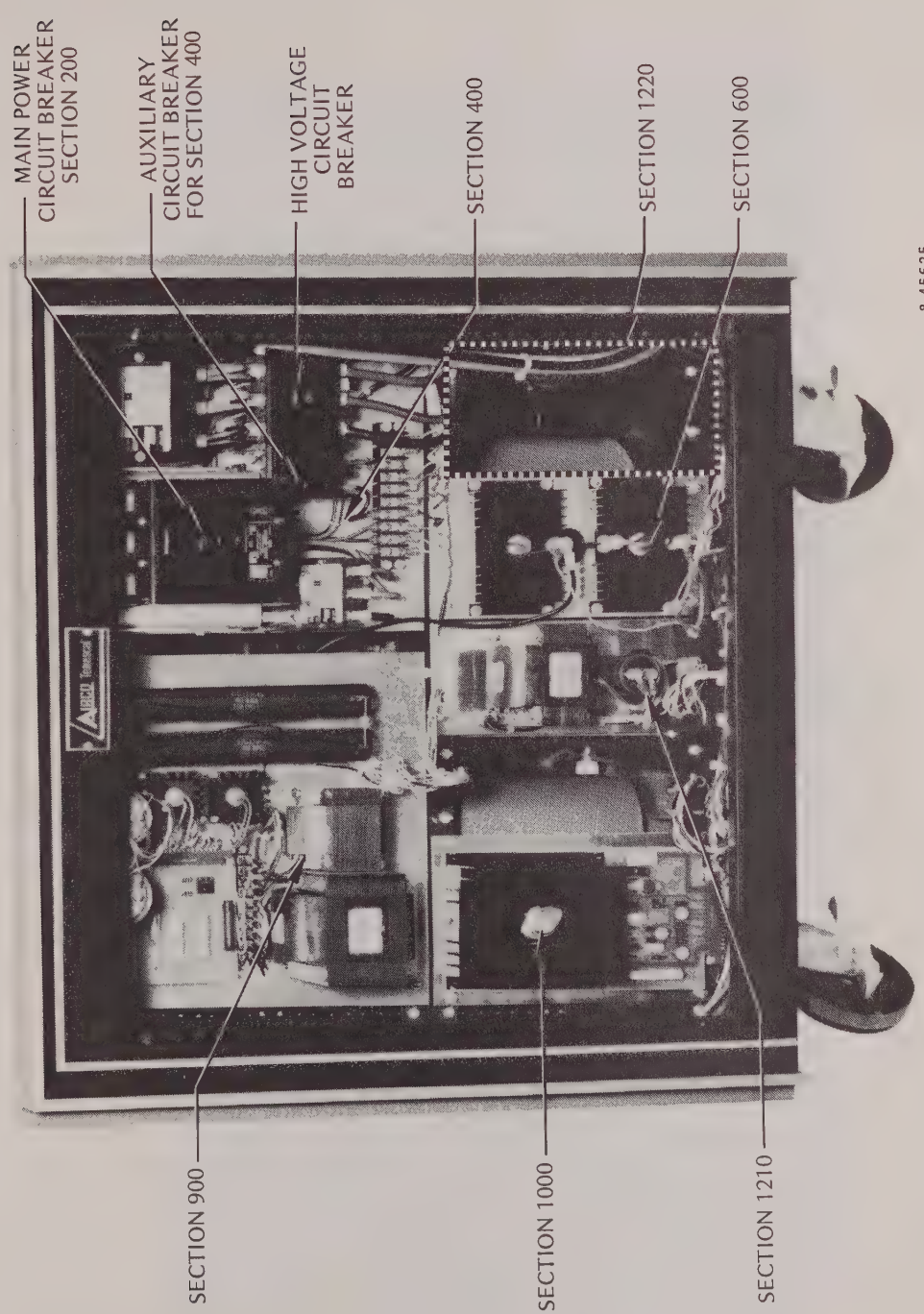


Figure 3-5. CV-8 A and B power supply module controls (front view)

Figure 3-6. CV-8 A and B control module, rear panel controls

SECTION 4

OPERATION

4.1 PRELIMINARY PRECAUTIONS

Before turning on the power supply for the first time, make sure that:

a) The low impedance ground is correctly installed.
b) The external interlocks are installed. Proper operation of the interlocks will be described later.
c) The electron beam gun(s) is correctly installed and has material in its crucible.

CAUTION

Read the entire section on operation to become familiar with controls and procedures before operating the power supply.

4.2 PRELIMINARY CONTROL SETTINGS (Figures 3-1, 3-4, 3-5, 3-2)

a) Main power circuit breaker: OFF
b) Key lock: OFF
c) VOLTAGE ADJUST: fully counterclockwise
d) EMISSION CONTROL(S): fully counterclockwise
e) BEAM POSITION control(s): mid-range
f) SWEEP controls (if used): fully counterclockwise
g) NORMAL-XYS-8 switch, if an XYS-8 is not used: NORMAL
h) NORMAL-XYS-8 switch, if an XYS-8 is used: set to the desired operating mode
i) Circuit breakers, CV-8 A and B and XYS-8 (if used): check that no circuit breakers have tripped during shipment. They should all be IN.
j) NORMAL-SS switches (SW-2 for gun No. 1, and SW-5 for gun No. 2): NORMAL (up) for electromagnetic focus guns, SS (down) for the Airco Temescal SuperSources. The up position includes a focus interlock and the down position bypasses the focus interlock.
k) Power supply module auxiliary circuit breakers: both ON

4.3 INITIAL TURN-ON (Figures 3-1 and 3-5)

NOTE
If any of the indicators or readings are abnormal, stop at once. Turn off the power supply and refer to section 7, Troubleshooting.

Turn ON the MAIN POWER CIRCUIT BREAKER. The POWER ON indicator on the HIGH VOLTAGE CONTROL panel should light. If the indicator does not light, turn the circuit breaker OFF and check the power service. If input power is present, check the auxiliary circuit breaker (CB2, section 400). Turn the circuit breaker ON. The AIR indicator and DOORS indicator should light.

4.3.1 External Interlock Check (Figure 3-1)

WARNING
All statements regarding operator and equipment safety are void if the external interlocks are bypassed.

a) Place the vacuum tank in operating position. The VAC TANK indicator should light. Verify that the indicator goes out if the vacuum tank access doors are opened.
b) Pump down the vacuum system. Monitor the tank pressure with the ion gauge that is connected in the interlock system.
c) The VAC GAUGE indicator should light when the desired operating pressure is achieved. (To change the interlock closing pressure, refer to the ion gauge manual.) Verify that the indicator light goes out if the vacuum gauge is turned off.
d) Turn ON the key lock. The P.C. CARDS & KEY LOCK indicator and the H.V. OFF control should light. Do not turn on the high voltage.
e) Turn OFF the key lock and remove the key.
f) Check the auxiliary interlock (if used). The AUXILIARY indicator should light when the interlock is closed. Turn on the gun cooling water. The GUN WATER indicator should light. The GUN FOCUS indicator and the FIL. OFF control should also light. If the GUN FOCUS indicator does not light, adjust the (longitudinal) BEAM POSITION control until it does.
g) Turn ON the filament power by pressing the FIL ON button. The FIL ON control should light and there

should be no emission current reading on the emission control meter. Position the meter switch to read FILAMENT CURRENT and adjust the SCR bias control, if necessary, so that the meter reads near the lower green line (figure 3-1).

h) Turn OFF the filament by pressing the FIL. OFF control.
i) Vary the (longitudinal) BEAM POSITION control and verify that the FOCUS interlock indicator goes out during overcurrent and undercurrent conditions (electromagnetic focus guns only).
j) Repeat the interlock checks and/or the bias adjustments for the second gun if one is used.
k) Turn ON the key lock. Make sure that the filament(s) is OFF. Turn ON the high voltage by pressing the H.V. ON button. The high voltage meter should indicate upscale. Turn the VOLTAGE ADJUST control clockwise. Verify that the high voltage meter reading increases. The high voltage may turn off after 20 seconds. This is normal and indicates a sustained under-voltage condition. To correct this, increase the high voltage to 7 kV or above.
l) Turn ON the filament(s), one at a time, and verify that there is less than 50 mA emission current on each gun. To adjust the SCR bias, refer to paragraph 6.1.4,d.
m) Turn OFF the filament(s).
n) Turn the key lock OFF. The high voltage should turn OFF.

This completes the installation checks. The power supply is now ready for normal operation.

4.4 NORMAL OPERATION

CAUTION

Before operating the power supply, the operator should read section 3 and the preceding paragraphs to become familiar with the controls and operating procedure.

a) Turn ON the cooling water flow to the elctron beam guns(s).
b) Turn ON the MAIN POWER CIRCUIT BREAKER. If conditions in the vacuum chamber are safe for operation, all interlock indicators will light with the exception of the P.C. CARDS & KEY LOCK and possibly the FOCUS indicators.
c) Turn the key lock ON. The P.C. CARDS & KEY LOCK and the high voltage ready (H.V. OFF control) indicators should light.

d) Turn ON the high voltage by pressing the H.V. ON button.
e) Adjust the VOLTAGE ADJUST control for the desired operating voltage.

Repeat steps f through k for each gun in use.

f) Set the (longitudinal) BEAM POSITION to mid-range. The FOCUS and filament ready (FIL.OFF control) indicators should light.
g) Set the EMISSION CONTROL fully counterclockwise and turn ON the filament by pressing the FIL. ON control.
h) Slowly advance the EMISSION CONTROL until a low reading is seen on the emission current meter.

NOTE
Do not exceed 0.05A emission current during this step.

At the same time, observe the electron beam gun. Advance the EMISSION CONTROL until the beam can be seen striking the crucible or another part of the gun. If the beam cannot be seen with 0.05A emission current, slowly turn the BEAM POSITION control(s) while looking for the beam. If the beam still cannot be seen, refer to section 7, Troubleshooting.

NOTE
Do not attempt to find the beam by increasing the emission current. Severe damage to the vacuum system might result.

i) Once the beam has been located, adjust the BEAM POSITION control to center the beam in the crucible pocket.
j) Slowly increase the emission current to the desired operating level to avoid spitting.
k) If rate monitors are used, adjust each rate range control as follows:
   1) Turn the rate range control fully clockwise (figure 6-3). This control is located on the gun P.C. board.
   2) Set the LOCAL/REMOTE switch (SW3/SW6) to the REMOTE (down) position.
   3) Slowly turn the rate monitor power, or level control, to 100% or maximum to avoid spitting.
   4) Rotate the rate range control counterclockwise until the maximum desired emission current level is reached. This should be no more than 0.8A.

This completes the rate range adjustment. Return all controls to their normal positions. Repeat for other rate monitors.

l) To turn off the power supply, turn off the filament(s), turn off the high voltage, and turn OFF the MAIN POWER CIRCUIT BREAKER.

Once the power supply has been adjusted, it may be turned on and off without disturbing the controls. This feature allows resumption of a production run without time consuming readjustments.

To turn the power supply on when the adjustments are preset, simply turn ON the MAIN POWER CIRCUIT BREAKER, turn on the high voltage, and finally, turn on the filament(s).

Either local or remote (rate monitor) emission current control for each gun may be selected at any time.

If an electron beam gun filament is changed, the SCR dial adjustments (see paragraph 4.3.1,g) and the beam position adjustments (steps f through j in this section) should be performed for the gun. In a multiple gun setup the other gun may be operated normally during these adjustments.

If the vacuum tank or electron beam gun installation is changed, refer to section 2, Installation, and paragraph 4.3.1, interlock check.

SECTION 5

THEORY OF OPERATION

5.1 OVERALL SYSTEM (Figure 5-1)

The CV-8 A and B power supplies utilize a single high voltage and regulator to provide high voltage for operating two electron beam guns simultaneously.

The high voltage direct current supply is basically a three-phase bridge rectifier with a nominal output of 12.5 kV. This voltage is divided between the electron beam gun and the power triode regulator. The return path from the electron beam gun is through the low impedance ground connection between the tank and power supply. The total current from all operating guns is sensed by the total current monitor in the cathode circuit of the power triode. The power triode acts as a controlled variable resistor to keep the voltage across the electron beam guns at the desired level.

The high voltage is regulated by the power triode which receives its control signals from the high voltage regulator section. This section compares a sample of the high voltage with a reference voltage set by the VOLTAGE ADJUST control signal. Samples of the high voltage across the guns are derived by the voltage divider networks to provide outputs for metering and control.

If the current through the total current monitor exceeds a preset value (usually 0.8A), the high voltage regulator transfers into a current control mode and adjusts the triode control signal to prevent the current from rising above the predetermined value.

The emission current for each gun is controlled by varying the temperature of its filament. Closed loop operation is possible only by monitoring the current in the high voltage lead to each gun. To eliminate hazardous floating meters and expensive high voltage isolation networks, a transductor is used for current monitoring. A transductor is a current sensing device which measures the magnetic field surrounding a current carrying wire. The output of the transductor is a voltage that is proportional to the current in the the high voltage lead, but is completely isolated from the high voltage.

In the GUN CONTROLLER, the transductor control output voltage is compared with a reference set by the EMISSION CURRENT control and adjusts the firing angle of an SCR pair in series with the gun filament transformer primary to maintain proper filament temperature. In the case of an arc-down, or similar low voltage operating condition, a signal from the voltage divider network cuts back the filament power to prevent overheating and possible damage to the filament.

The electron gun filament is operated at a high negative potential with respect to the material to be evaporated. If the electrons were accelerated in a straight line (line-of-sight) to the crucible, the filament life would be shortened considerably due to contamination and ion bombardment. To extend filament life, the filament is located out of the line-of-sight of the crucible and the electron beam is bent by a magnetic field so that it will strike the evaporant.

The magnetic field is provided by the electromagnetic focus coil in the electron beam gun assembly. Current for the coil is provided by the beam position (focus) supply. The beam position supply provides an adjustable current for the longitudinal focus coil. The coil bends the beam the required amount. As current is varied in the coil, the beam position changes. The beam position supply is also equipped with a sensing circuit which keeps a GUN FOCUS interlock open unless the focus current is within specified limits.

The optional XYS-8 sweep control is capable of sweeping the beam in both longitudinal and lateral directions. The two sweep circuits are isolated from each other and both are adjustable for sweep frequency and amplitude as well as beam position.

The longitudinal sweep circuit drives through the standard beam position circuits and maintains the beam position (GUN FOCUS) interlock operational.

5.2 HIGH VOLTAGE SECTION, CIRCUIT DESCRIPTION

5.2.1 High Voltage Power Supply (Figure 5-2)

The high voltage power supply consists of a high voltage power transformer and a three-phase fullwave rectifier. A resistance-capacitance (R-C) network across each secondary protects the rectifiers from transients. A bleed resistor is used to discharge the supply when input

power is removed. The output of the rectifier is protected by the combination of an R-C filter and series surge limiting resistors.

5.2.2 Triode Cathode Bias Network and (High Voltage Regulator) Power Supplies (Figure 5-3)
To eliminate the need for an additional power supply, the cathode of the triode is held at 75V by Zener diodes in the cathode circuit. A portion of the 185V power supply is used to ensure that the Zeners are always forward-biased. This supply also provides power to the control grid driver.

5.2.3 High Voltage Regulation (Figures 5-4 and 5-5)
On the high voltage regulator block diagram, the positive reference voltage from the VOLTAGE ADJUST control is summed with the negative high voltage sample from the voltage divider network. The resultant voltage at the summing junction is just enough to keep the amplifier operating in its linear region. The amplifier output is then passed through a gate to the power amplifiers which then feed the grid of the power triode. In an overcurrent condition, the gate passes the overcurrent signal instead of the voltage control signal and the system becomes a current regulator rather than a voltage regulator.

5.2.4 High Voltage Dividers (Figure 5-6)
Four independent high voltage dividers provide the control and metering signals necessary for proper operation. These dividers also provide a bleeder path to ground for the high voltage supply. One divider sends a high voltage sample to the regulator circuits. This divider terminates at the top of the current sensing resistors, not at chassis ground.

The second divider provides a signal to the under-voltage trip circuit relay in the high voltage control. A Zener diode limits the voltage across this relay. This divider is also referenced to the top of the current sensing resistors.

The third divider provides a signal to the high voltage meter located on the control console. A shunt resistor supplies protection from high voltage should the meter movement open.

The fourth divider provides an under-voltage cutback signal to the gun controllers.

5.3 ELECTRON GUN CONTROLLER

5.3.1 Overall Operation (Figure 5-7)

The electron beam gun is operated in an emission limited condition. The filament temperature determines the emission capability of the filament and hence the beam current. The filament temperature is controlled by the power available to the primary of the filament transformer.

For closed-loop operation, the current in the high voltage lead is sensed by the transductor circuits. The current signal is then summed with a reference voltage provided by either the EMISSION CONTROL or by an external, customer-supplied, rate monitor. The summed signal is amplified and is used to control the firing of a SCR pair in the filament transformer primary circuit. The conduction angle of the SCR pair determines the power supplied to the filament transformer primary winding.

If the high voltage is off when the filament is turned on, the filament will be driven at full power trying to supply the current that the EMISSION CONTROL demands. This condition will overheat and very likely damage the filament. To prevent overdriving the filament, a high voltage signal switches on the regulator and transductor summing amplifier. With no high voltage present, the SCR firing circuit receives no control signal and remains cut back.

The minimum current through the filament is adjusted by the SCR bias control to keep the filament just below emitting temperature so that the filament does not have to undergo a full temperature cycle every time the high voltage drops or the EMISSION CONTROL is turned to zero.

5.3.2 Transductor Current Sensing (Figure 5-8)

Emission current monitoring is accomplished by a transductor head in each high voltage electron beam gun lead. The transductor head is an encapsulated toroidal saturable reactor with two direct current windings and one alternate current winding. One of the direct current windings is the high voltage lead through the center of the toroid. The other direct current winding carries about 10 mA of bias current which is necessary to keep the transductor operating in its linear range. The third winding carries enough alternating current to saturate the core on peaks. As the total direct current flowing in the bias and high voltage windings is increased, the core saturates at a lower value of alternating current. This impedance

change is sensed by rectifying the alternating current. The rectified voltage change is proportional to the change of the total direct current flowing in the transductor head. Since the bias current is constant, the output voltage is proportional to the current in the high voltage lead.

The signal is current amplified and drives the emission current meter through the meter full scale adjust control and the meter switch. The amplified signal is also sent to the gun control circuit board.

5.3.3 Emission Control (Figure 5-9)

Power for the gun control circuit is supplied by a transformer and its associated full wave rectifier. To protect the filament from thermal shock when power is applied, the filament power is slowly increased. This is controlled by charging the power supply capacitors and takes approximately 500 milliseconds.

The reference voltage for the emission control circuits is obtained from either the EMISSION CONTROL or the conditional external rate monitor signal. The reference voltage source is selected by the LOCAL/REMOTE switches (SW3/SW6) (figure 3-4) on the circuit breaker panel.

If a positive rate signal is used, inverting and level shifting amplifiers are used by connecting pins 1 and 3 on the circuit board. If a negative signal is used, the amplifier is bypassed by connecting pins 1 and 2. The rate range potentiometer adjusts the rate input signal.

Metering the filament primary current is accomplished by rectifying the voltage across a current sensing resitor.

5.4 BEAM POSITION (FOCUS) CIRCUITS

The electron beam gun filament is placed out of the line-of-sight of the source crucible to prevent ion bombardment and contamination. The electron beam is bent by the beam position control (focusing current) so that it strikes the evaporant material.

The magnetic field necessary to position the beam is provided by a controlled circuit in the longitudinal focus coil. This current also controls the GUN FOCUS interlock which prevents the application of filament power unless the longitudinal focus current is within its desired limits. A switch is provided to defeat

the interlock if a permanent magnet electron beam gun is used.

5.4.1 (Longitudinal) Beam Position (Focus) Control (Figures 5-10 and 5-11)
The longitudinal BEAM POSITION control uses a direct coupled amplifier. Negative feedback is provided by referencing the amplifier to the top of the output current sensing resistor.

The output transistor drives the focus coils through a metering resistor and transient suppressor. For permanent magnet guns, a current limiting resistor is switched in series with the focus coil.

The power supply for the beam position control circuit is a full wave bridge with the positive side grounded. The output is therefore 30V negative with respect to chassis ground.

5.4.2 Beam Position (Focus) Interlock (Figure 5-12)
The focus interlock circuit energizes an interlock relay, only if the longitudinal beam position current is within the limits set by the low and high limit controls and the focus coil is not short-circuited.

5.5 SWEEP CIRCUITS (Optional) Figures 5-13, 5-14, and 5-15)
The sweep generating circuits are identical for the lateral and longitudinal sweeps. The only difference between the two are in the output stages and in the circuit location of the beam position controls. The lateral sweep generating circuit will be discussed.

The sweep is generated by transistors Q1 through Q4. They function as constant current sources with Q1 supplying approximately twice the current of Q2. At the beginning of each cycle, Q1 charges the switch selected timing capacitor through CR1. Since the capacitor is being charged with a constant current, the voltage rise across the capacitor will be a linear ramp. The linear ramp continues until the firing voltage of Q3, a uni-junction transistor, is reached. When Q3 fires, diode CR1 is reverse-biased, isolating the timing capacitor from current source Q1. Q1 now supplies the holding current for Q3. The timing capacitor discharges linearly through Q2, the other constant current source. The capacitor will discharge until CR1 is forward-biased, at which point current source Q1 is again connected to Q2 and the timing capacitor. The current through Q3 now drops

below the holding value and Q3 turns off. The output triangle waveform is current amplified by Q4.

The output of Q4 then goes to A1, an operational amplifier, through the SWEEP control R6. The sweep waveform is summed with the negative feedback from the output amplifier and the voltage from the BEAM POSITION control R5.

The output of A1 is connected to Q7 through a voltage level shifting network zero adjust, R39, R16, and CR2. Q7 drives the complementary symmetry output amplifier. The BEAM POSITION control is a front panel control for the lateral and longitudinal sweep supply and is a service adjustment for the longitudinal sweep supply. The longitudinal beam position can also be controlled by the BEAM POSITION control discussed in the BEAM Position (Focus) Control section, (paragraphs 5.4.1 and 5.4.2).

5.5.1 Lateral Sweep Output (Figure 5-14)
Q5, Q6, Q8, Q9, Q1, and Q2 form a complementary symmetry power amplifier that drives the lateral focus coil through the transient suppressor Z20. The average current is measured across R1 with the meter calibrating resistors R20 and R22 which are located on the longitudinal focus board. To prevent ground loops, the lateral focus coil common (return) lead should not be grounded externally.

5.5.2 Longitudinal Sweep Output (Figure 5-15)
Since the longitudinal sweep amplifier has only to drive the longitudinal focus board, the high power output transistors Q6 and Q9 are eliminated from this section and from figure 5-15. The longitudinal sweep amplifier drives the input to the focus board through 2640SW8 and 2640R1, the BEAM POSITION control.

5.6 PRIMARY POWER (Figures 5-16, 5-17, and 5-18)
The three-phase input is applied to the 50A [35A] MAIN POWER CIRCUIT BREAKER. Power from the circuit breaker is applied to the control transformer, to the high voltage step-start panel, and through a 5A circuit breaker to the longitudinal focus and GUN CONTROL power supplies. The control transformer output is connected directly to the MAIN 15A circuit breaker that in turn feeds the other primary power circuit breakers.

A 5A circuit breaker is in series with the primary interlocks. The AIR interlock must be satisfied to energize the relay that applies power to the triode filament, the triode bias, and the high voltage regulator power supplies.

The control power interlocks will not allow the high voltage to be turned on unless triode cooling air is present in the required amount, the VAC TANK and VAC GAUGE interlocks are satisfied, and the removable panels and printed circuit boards are in place. The front panel key lock switch must also be turned ON. Front panel indicator lights show which interlocks are closed.

5.6.1 High Voltage Control (Figure 5-19)
For equipment safety, the high voltage control circuits will not remain energized unless high voltage and focus power are present. When the H.V. ON control is pressed, the control latch relay and a time delay relay are energized. If the time delay relay is allowed to remain energized for 20 seconds, it will open the primary control line which de-energizes the latching relay and turns the high voltage OFF. The time delay relay will not energize if the focus power supply and the high voltage circuitry are operating normally. The relay will also shut off the high voltage to prevent overheating of the power triode in case of a sustained (20 second) high voltage short.

5.6.2 High Voltage Step-Start (Figure 5-20)
The step-start circuit protects the high voltage circuits from damage caused by high inrush currents. On initial voltage application the circuit inserts resistance in series with the high voltage transformer primary. It then bypasses the resistance after 200 milliseconds.

When the H.V. ON button is pressed, a relay latches the H.V. ON button. Another relay connects the high voltage transformer primary to the line through series resistors. When a time delay relay closes 200 milliseconds later, it energizes another relay which also closes a set of contacts used to power optional high voltage warning lights at the tank.

5.6.3 Gun Control Primary Power (Figure 5-21)
The GUN CONTROLLERS are also provided with an interlock system that includes interlocks at the vacuum tank (GUN cooling WATER and AUXILIARY), and the beam position (GUN FOCUS). Filament power cannot be applied to the electron beam gun unless these interlocks are satisfied.

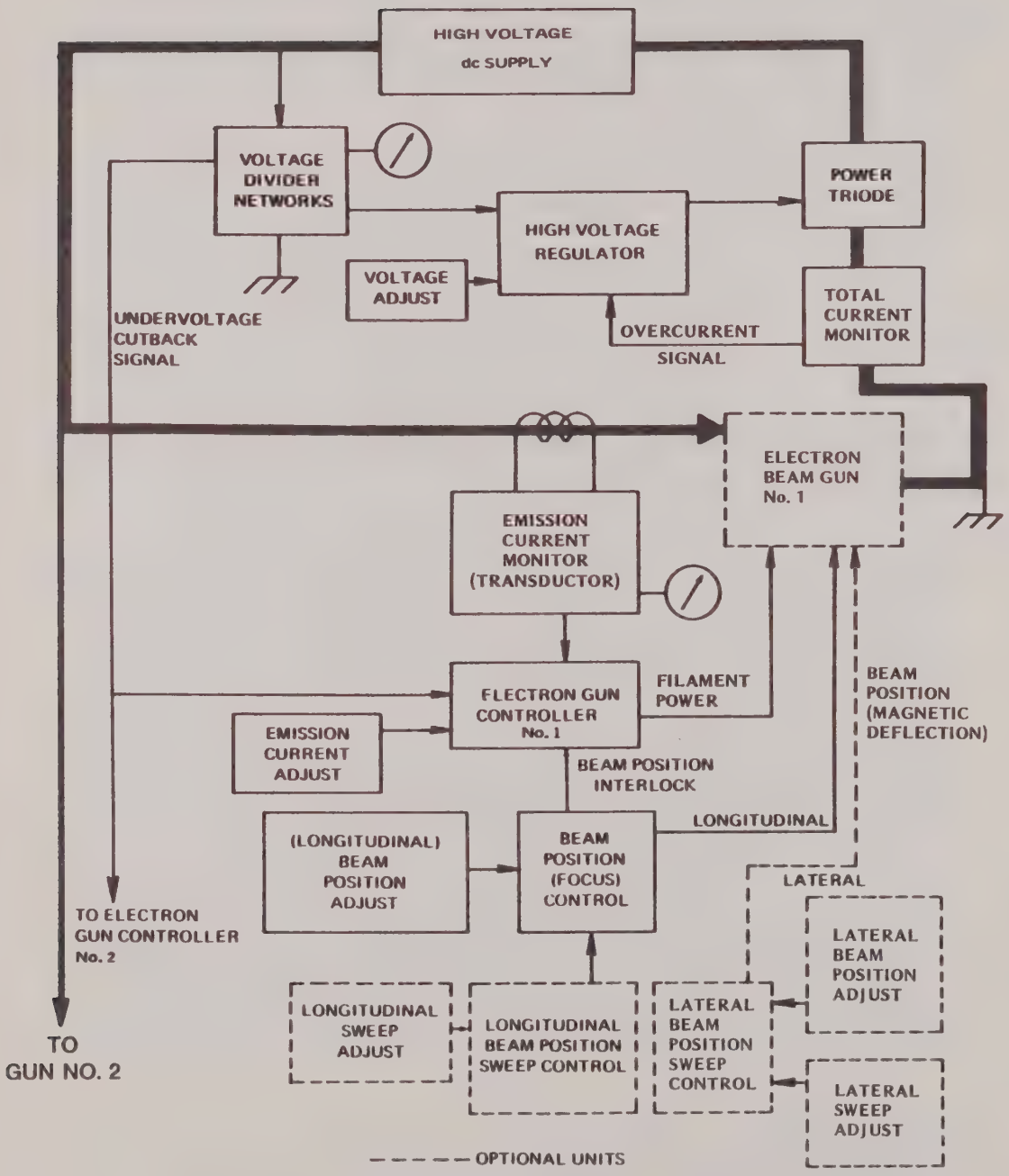


Figure 5-1. CV-8 A and B system block diagram

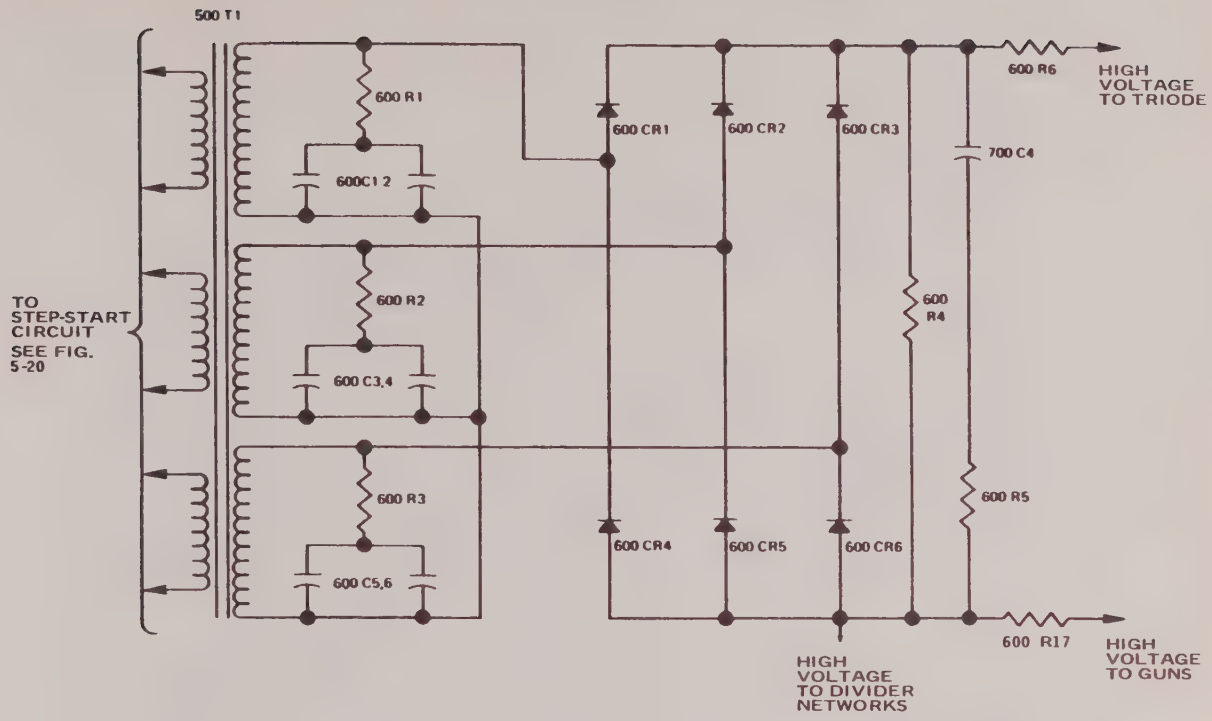


Figure 5-2. CV-8 A and B high voltage power supply (drawings 506-0445 sheet 1)

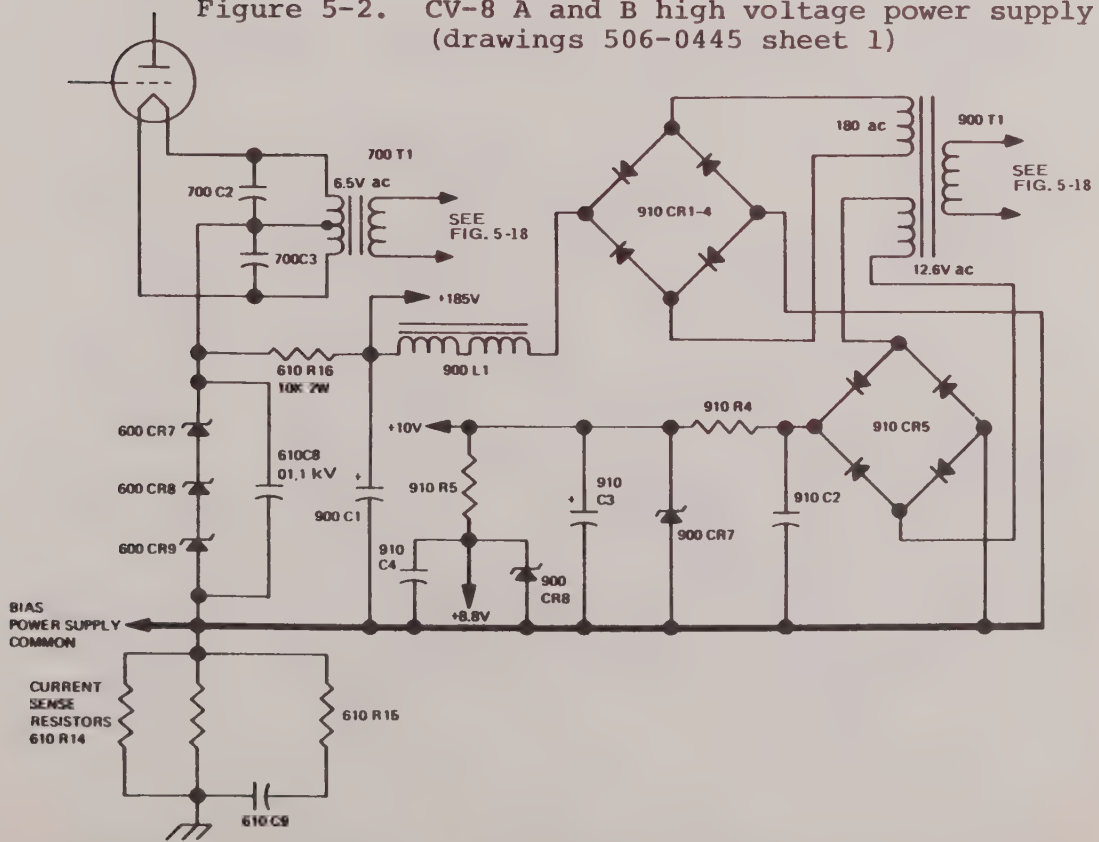


Figure 5-3. CV-8 A and B triode cathode network and bias (high voltage regulator) power supply (drawing 506-0445 sheet 1)

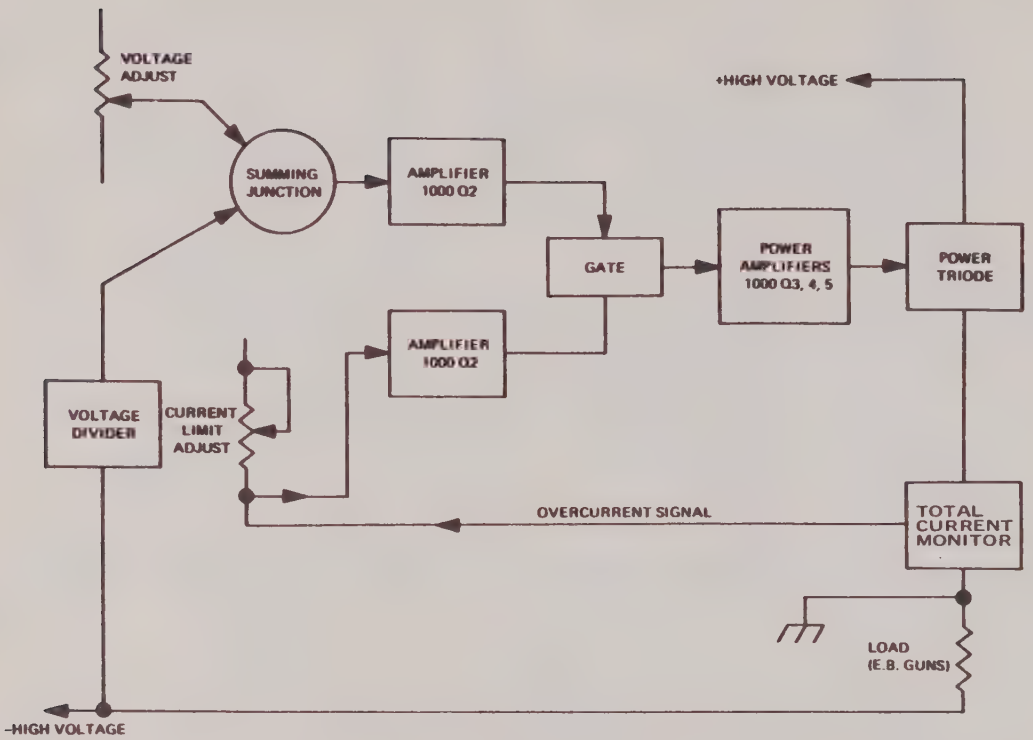


Figure 5-4. CV-8 A and B high voltage regulation block diagram

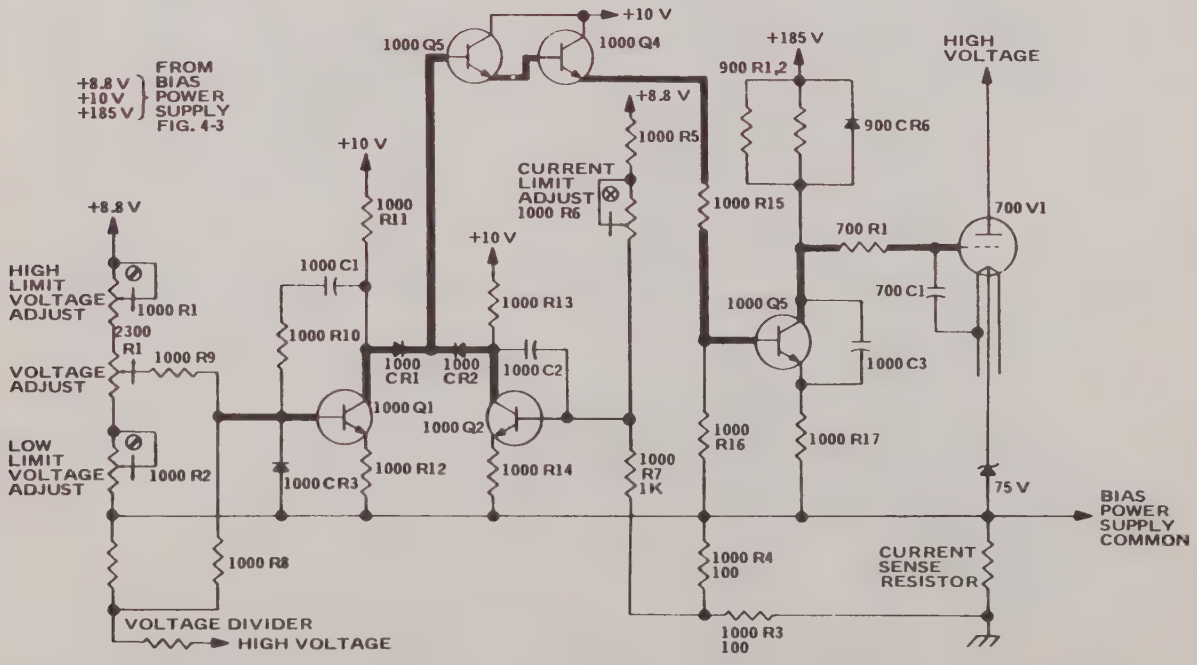


Figure 5-5. CV-8 A and B high voltage regulator (drawing 506-0445 sheet 1)

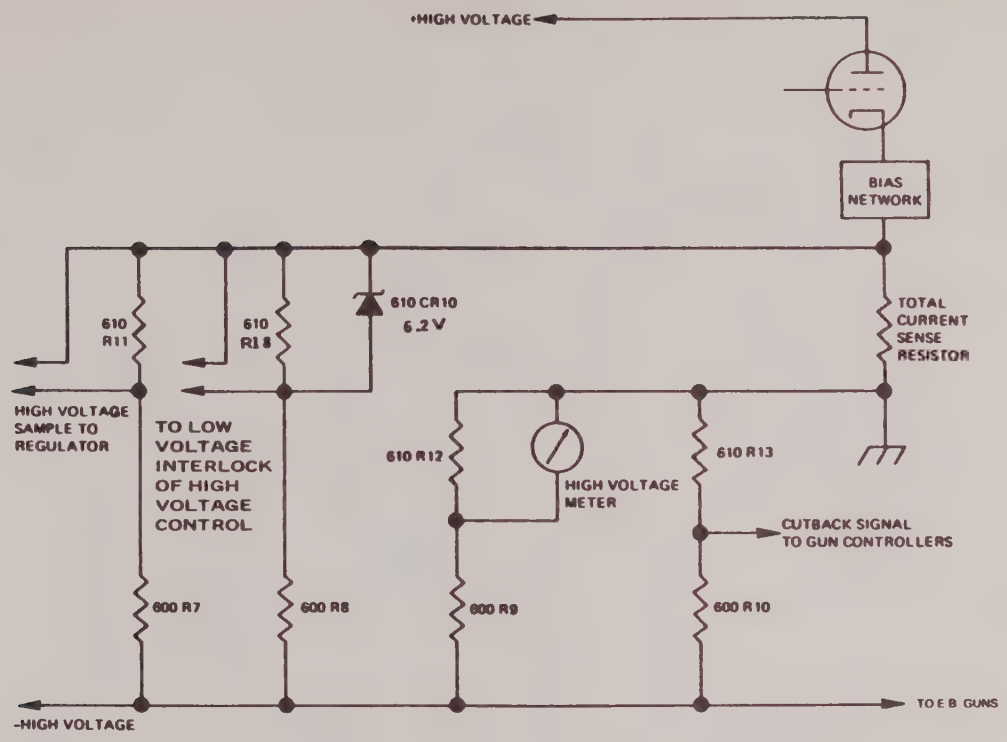


Figure 5-6. CV-8 A and B high voltage dividers (drawing 506-0445 sheet 1)

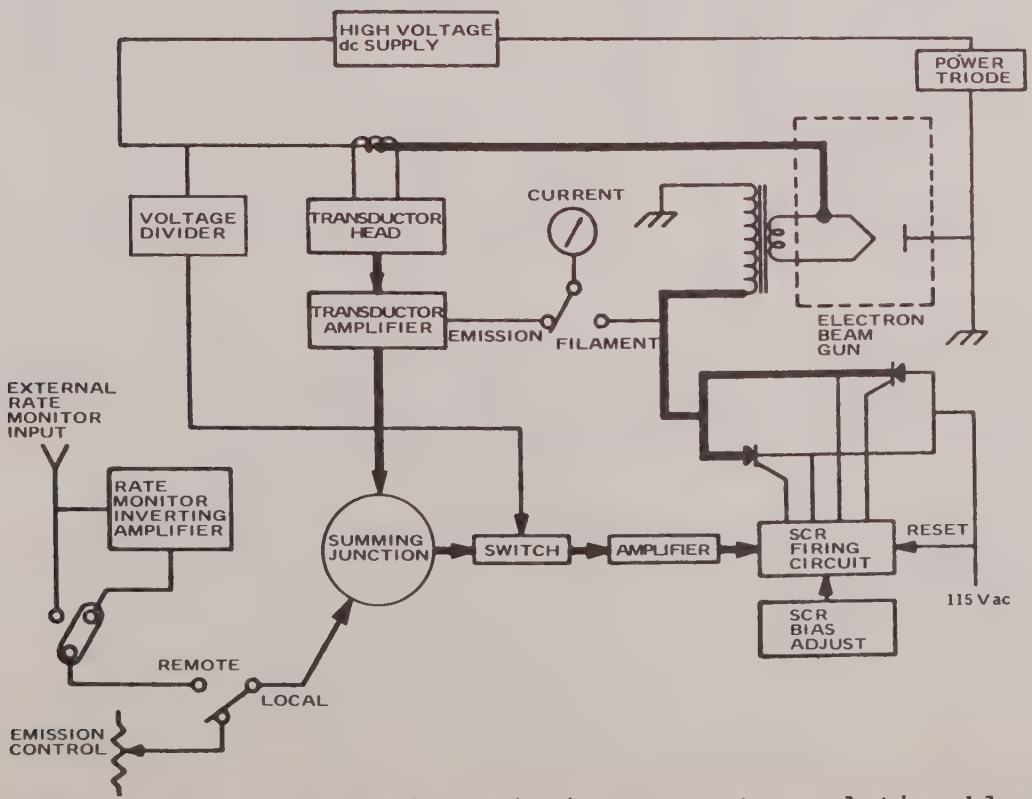


Figure 5-7. CV-8 A and B emission current regulation block diagram

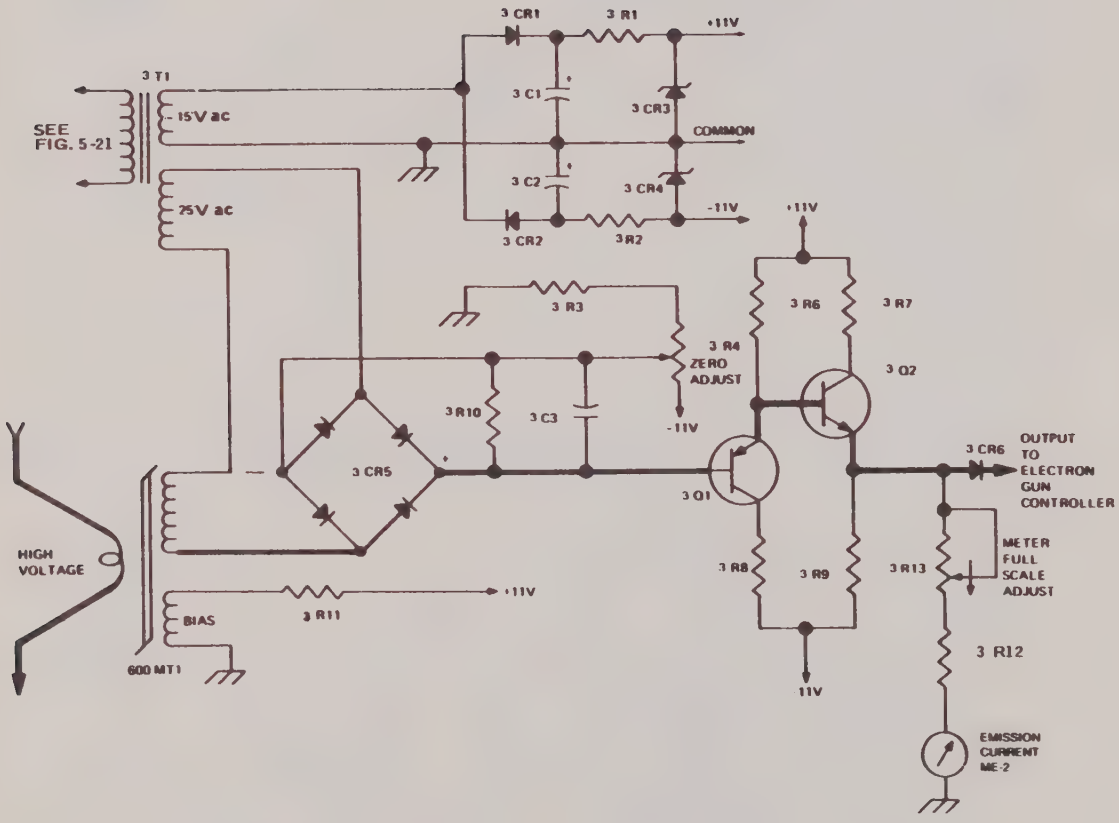


Figure 5-8. CV-8 A and B transductor circuits (drawing 307-4933D)

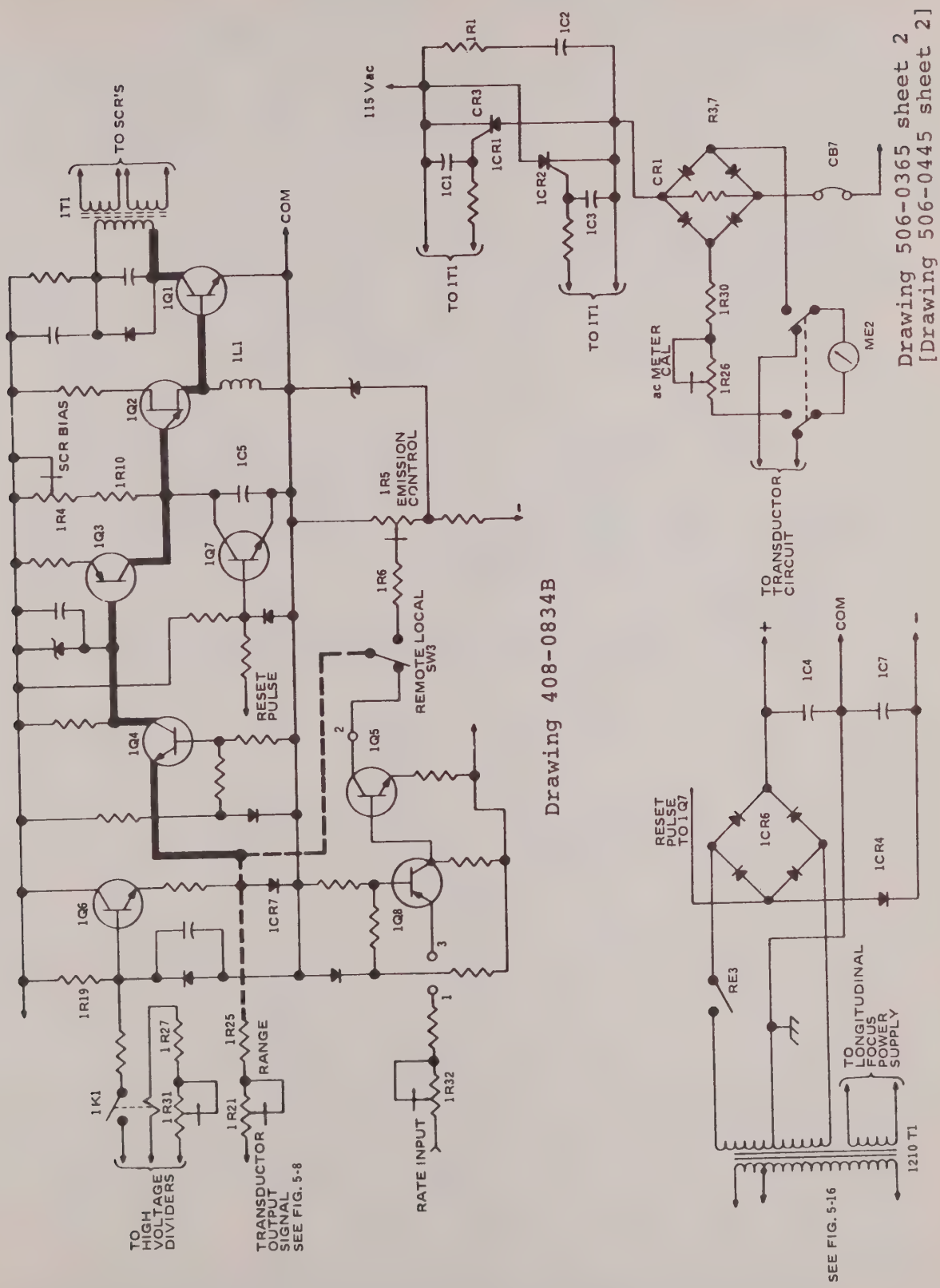


Figure 5-9. CV-8 A and B electron gun control circuit

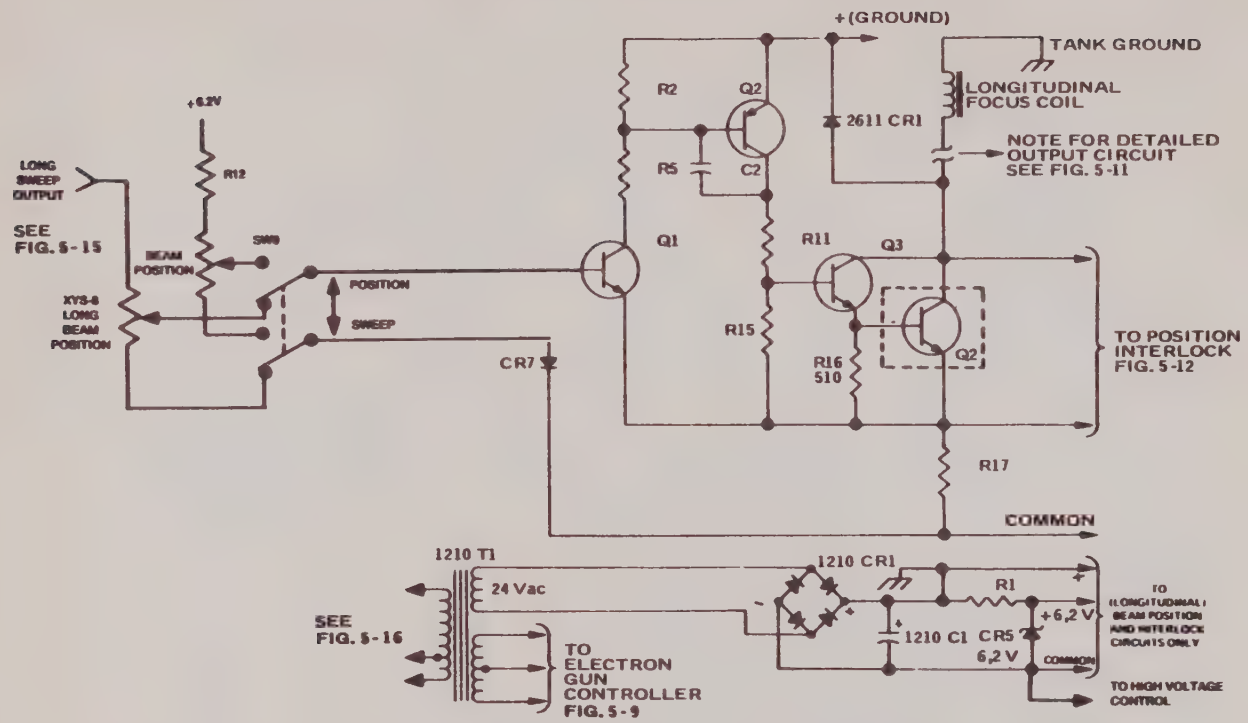


Figure 5-10. CV-8 A and B longitudinal beam position (focus) control circuit (drawing 407-3863C)

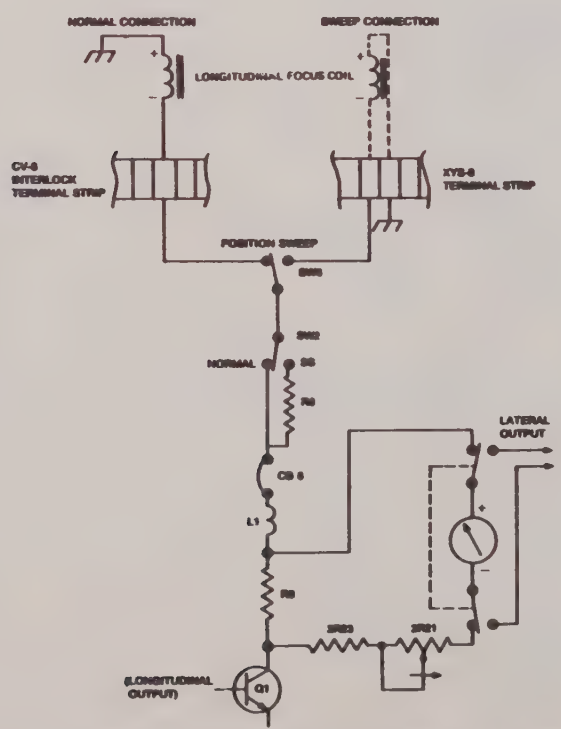


Figure 5-11. CV-8 A (drawing 506-0365 sheet 2) and CV-8 B [drawing 506-0445 sheet 2) longitudinal beam position output

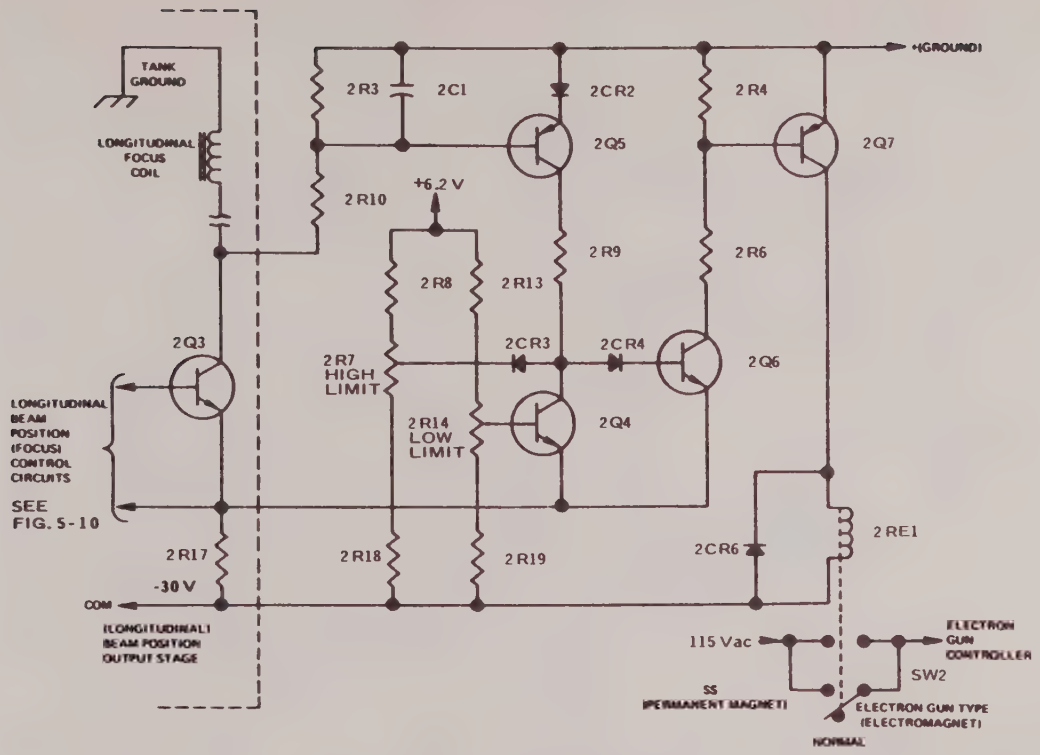


Figure 5-12. CV-8 A and B beam position (focus) interlock (drawing 407-3863C)

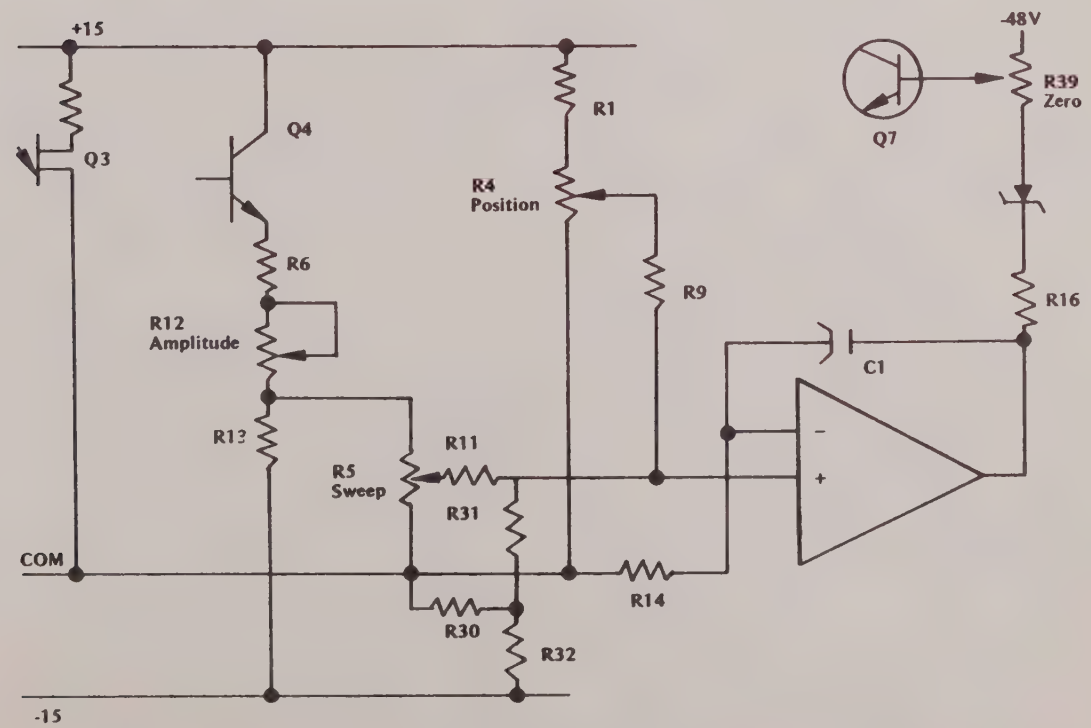


Figure 5-13. CV-8 A and B sweep generator schematic (drawing 409-4533)

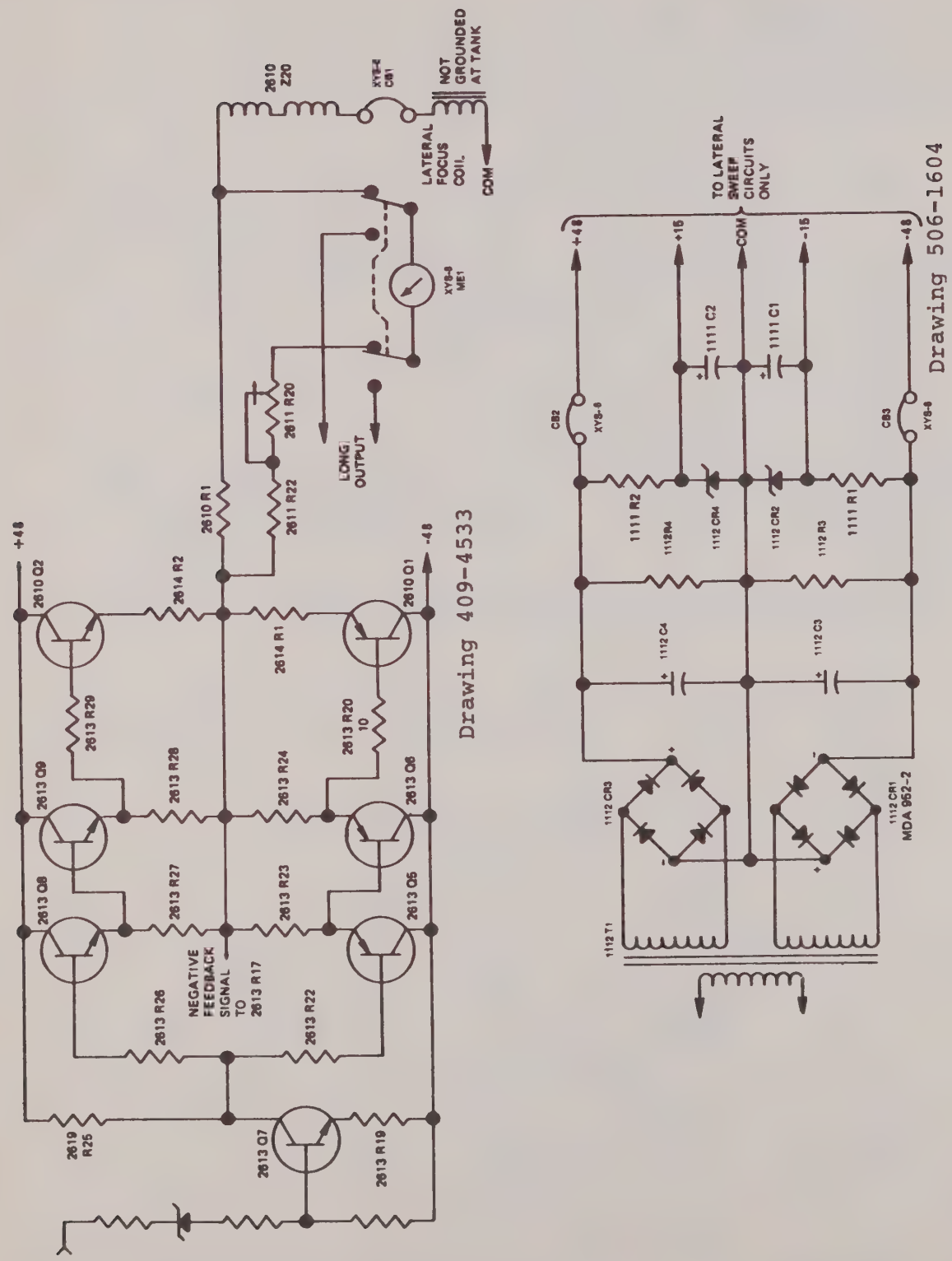


Figure 5-14. CV-8 A and B lateral sweep output and lateral sweep power supply

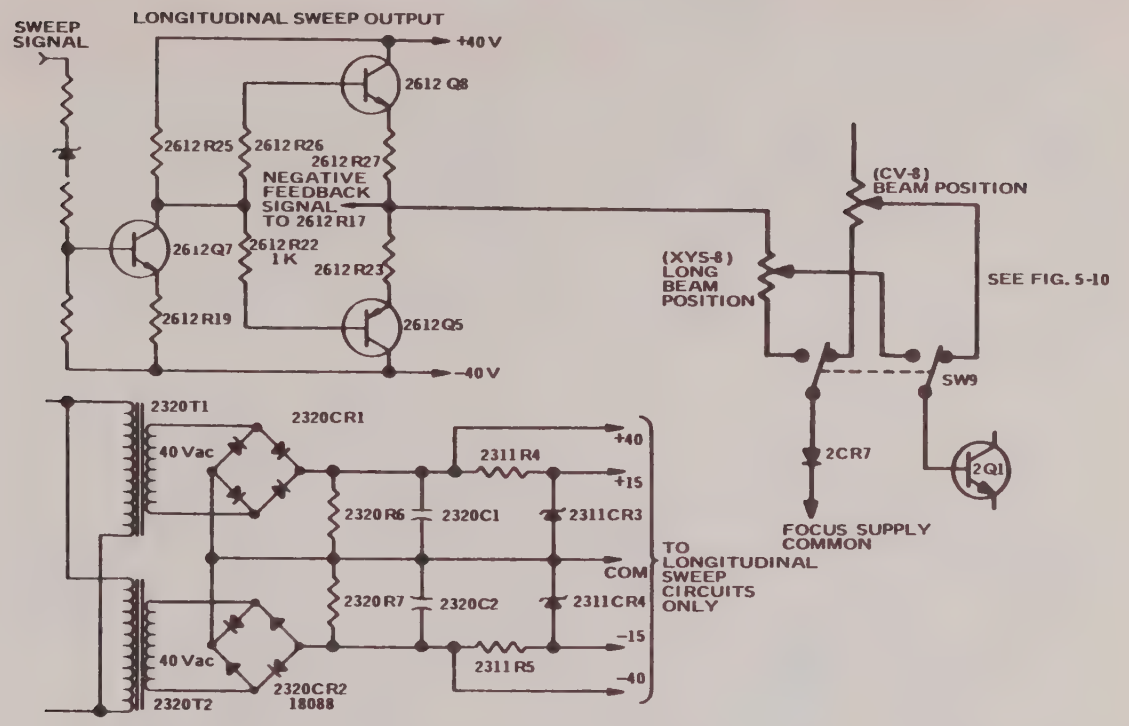


Figure 5-15. CV-8 A and B longitudinal sweep power supply (drawing 506-1604)

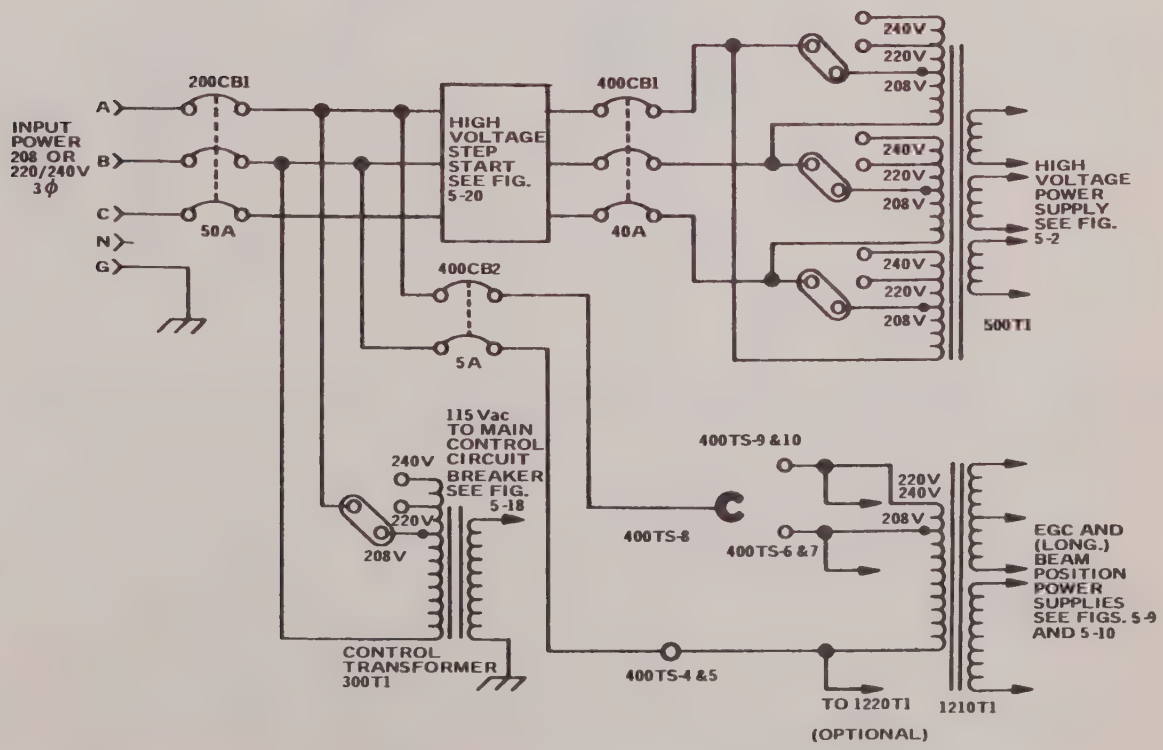


Figure 5-16. CV-8 A primary power (208/220/240V) input

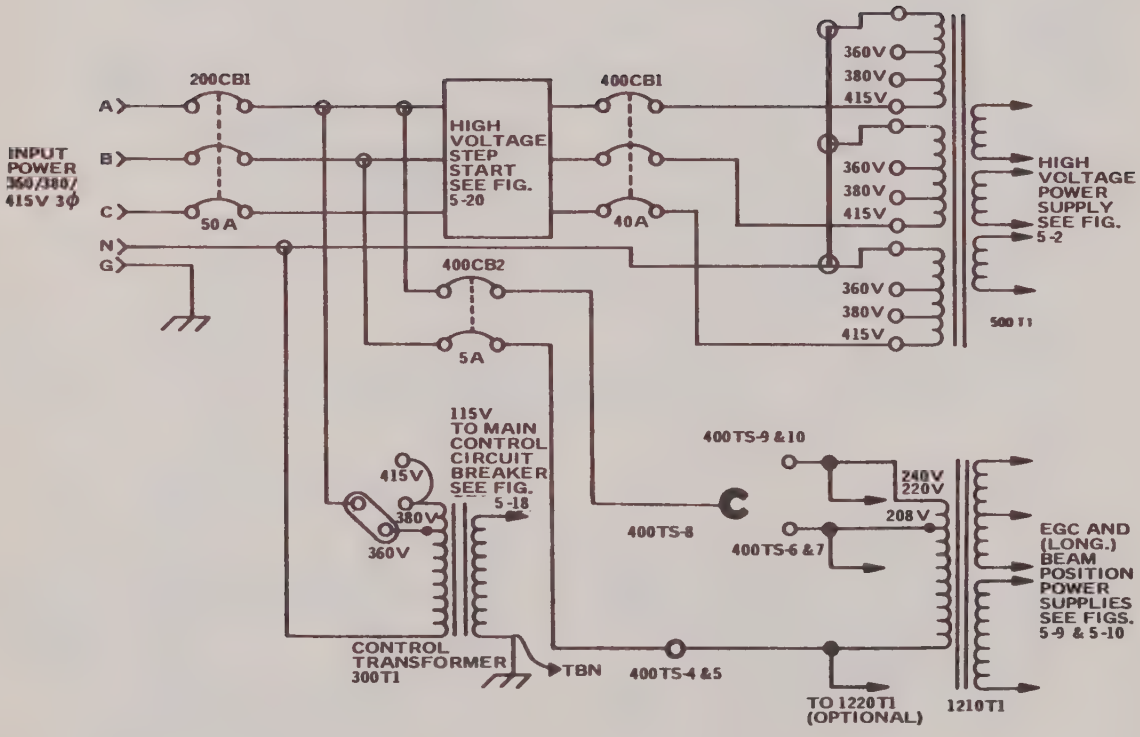


Figure 5-17. CV-8 B primary power [360/380/415V] input [drawing 506-0445 sheet 1]

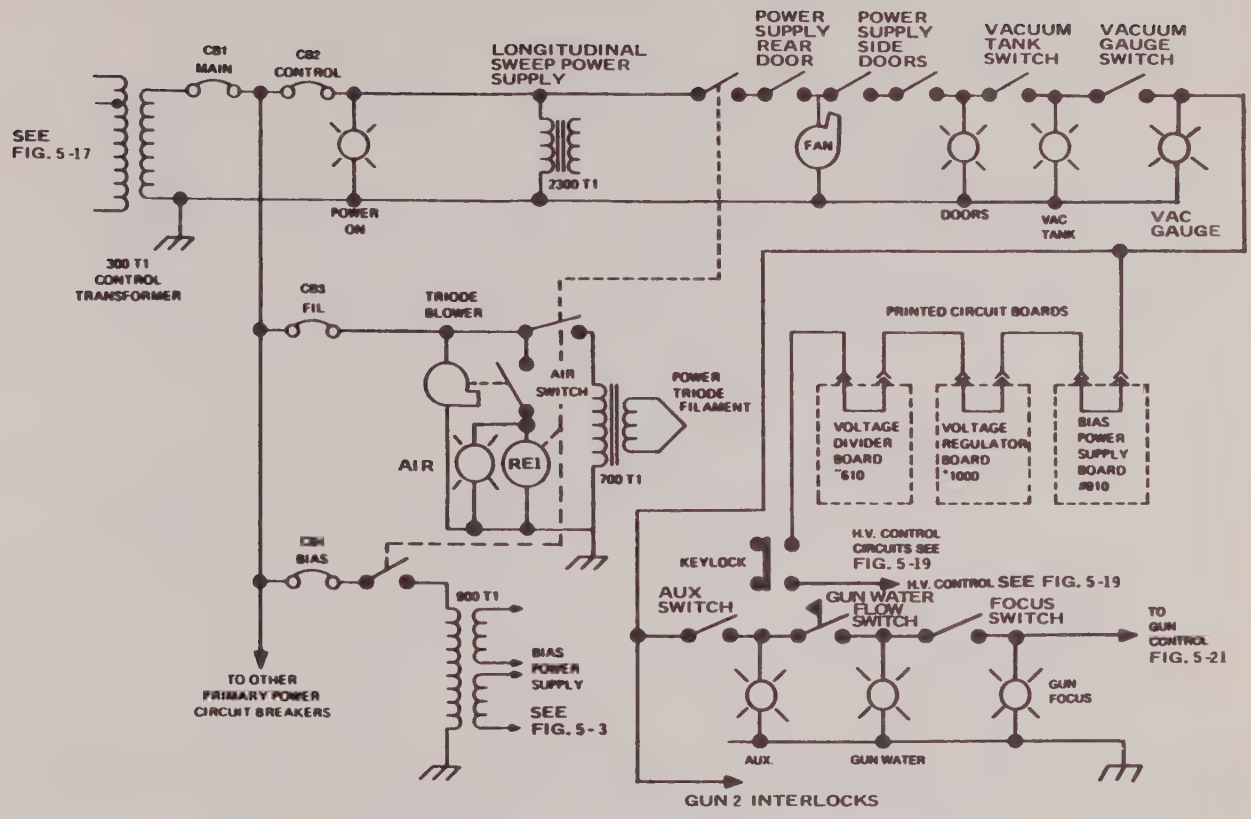


Figure 5-18. CV-8 A and B high voltage control interlocks

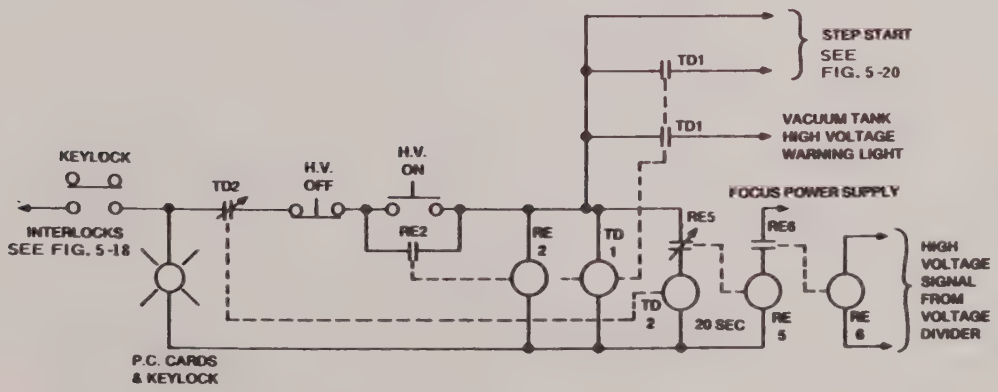


Figure 5-19. CV-8 A and B high voltage control

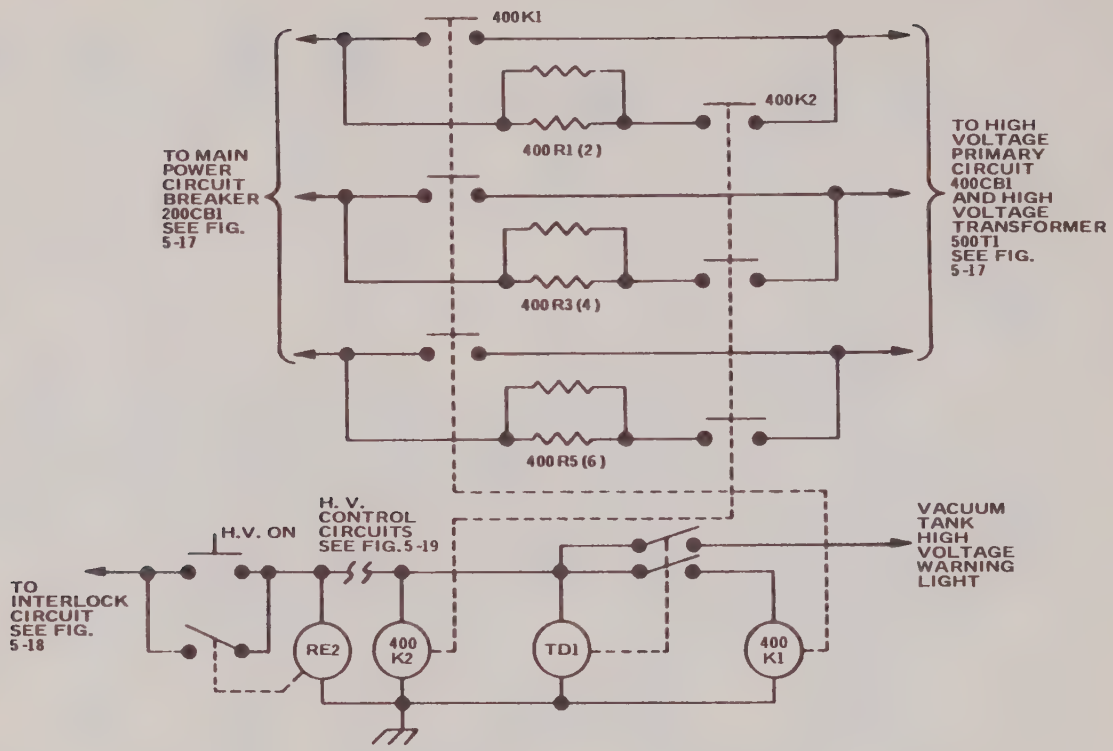


Figure 5-20. CV-8 A (drawing 506-0365 sheet 1) and CV-8 B [drawing 506-0445 sheet 1] high step-start

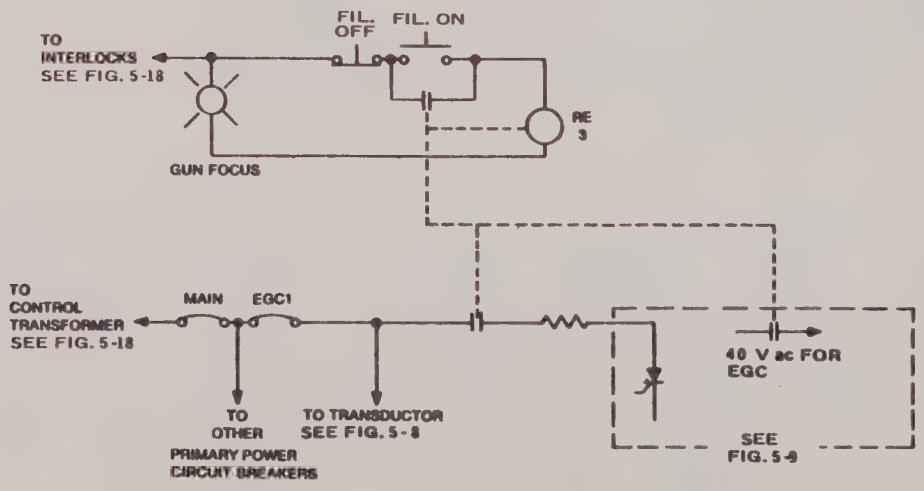


Figure 5-21. CV-8 A (drawing 506-0365 sheet 2) and CV-8 B [drawing 506-0445 sheet 2] electron gun control primary power

SECTION 6

MAINTENANCE

The CV-8 A and B power supplies require minimum periodic service. The only maintenance required is cleaning. The air filter located on the rear should be checked at least every thirty days and cleaned or replaced if necessary. At the same time, a visual inspection of the interior of the two modules should be made. If dust, dirt, or grease have accumulatd inside the enclosure, it should be cleaned by vacuuming or washing with a solvent.

CAUTION
Read the high voltage warning at the front of this manual before opening the enclosure.

6.1 SERVICE ADJUSTMENTS

6.1.1 Voltage Changeover

Taps are provided for either 208/220/240V [360/380/415V] alternating current on all transformers operated directly from the input power line. To change the voltage requirements of the power supply:

a) Disconnect the service power to the power supply.
b) Remove the front and left side panels.
c) Reconnect the four [one] links located on the high voltage transformer to the desired voltage (figure 6-5).
d) Reconnect the jumper from 400TS-8 to either 400TS-7 for 208V [360V] or 400TS-9 for 220/240V [380/415V] (figure 6-1).

NOTE
400TS is the terminal strip located under the auxiliary circuit breakers.

e) Replace the panels and reconnect the service power.

6.1.2 Adjustment of Variable Components

IMPORTANT
The following components are factory adjusted and should not be tampered with.

a) Current limit adjust, 1000 R6.
b) Low voltage limit adjust, 1000 R2.

6.1.3 Power Supply Adjustments (Figure 6-1)

a) HIGH LIMIT VOLTAGE ADJUST, 1000 R1

CAUTION
High voltage is present during this adjustment.

1) Turn the VOLTAGE ADJUST control fully clockwise (maximum).
2) Turn ON the high voltage.
3) Adjust 1000 R1 for a reading of 10.2 kV on the high voltage meter.
4) Due to interaction, check the low limit adjustment, below.

b) LOW LIMIT VOLTAGE ADJUST, 1000 R2

CAUTION
High voltage is present during this adjustment.

1) Turn the VOLTAGE ADJUST control fully counter-clockwise (minimim).
2) Turn ON the high voltage.
3) Adjust 1000 R2 for a reading of 5 kV on the high voltage meter.
4) Due to interaction, check the high limit adjustment above.

c) CURRENT LIMIT ADJUST, 1000 R6

WARNING
The following adjustment delivers over 8 kW to the crucible. Use extreme caution to prevent damage to the electron gun.

1) Turn 1000 R6 fully counterclockwise (minimum).
2) Adjust the high voltage for 10 kV.
3) Select a SINGLE gun controller that is connected to an operable vacuum system and turn the EMISSION CURRENT control fully counterclockwise (minimum).
4) Turn the filament ON and slowly advance the emission current until current limiting starts. When this point is reached, the high voltage will decrease, but the emission current will stay relatively constant. During this adjustment, observe the beam and adjust the position if necessary.
5) Turn 1000 R6 clockwise until current limiting starts at 0.7A emission current.

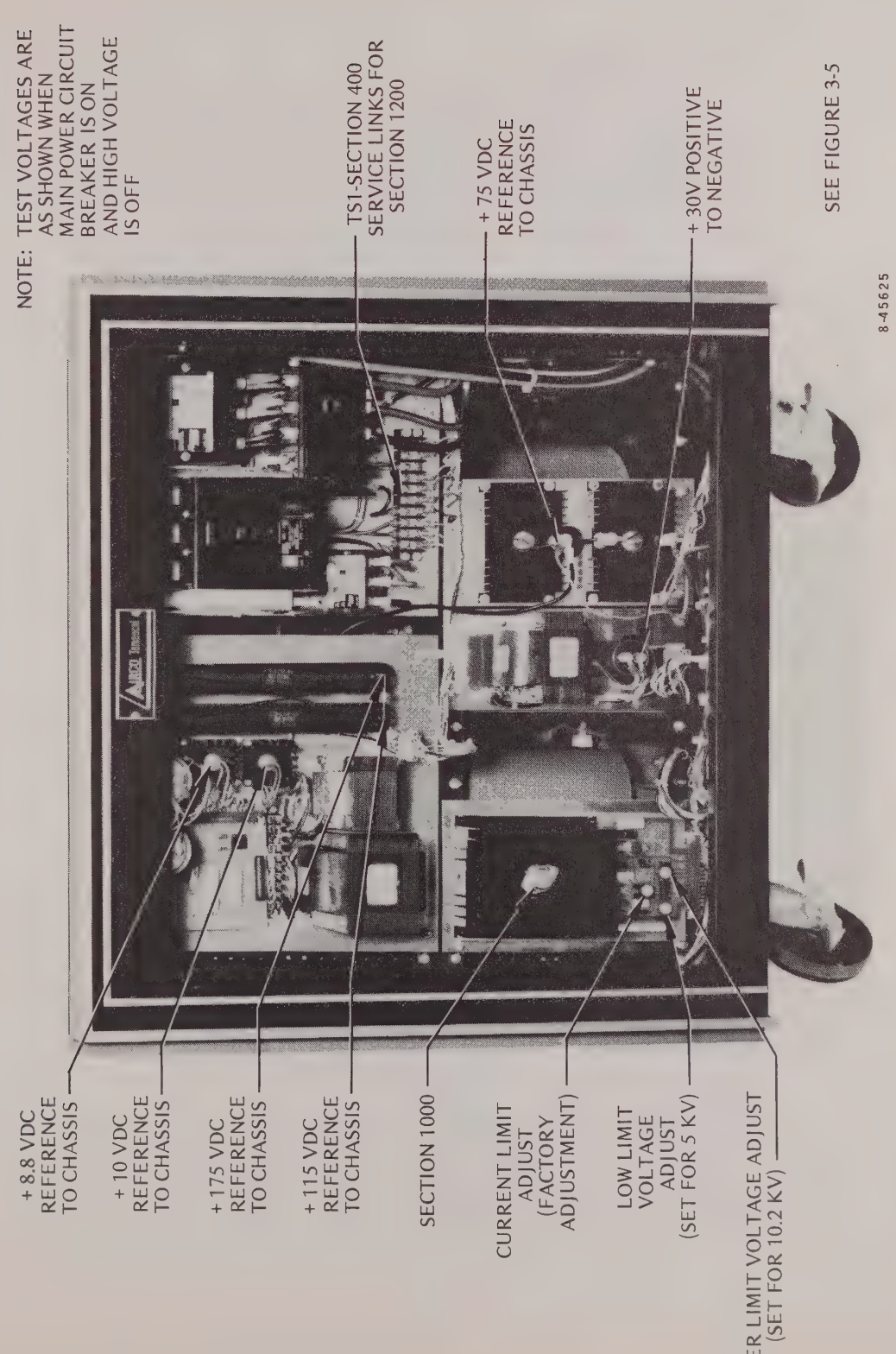
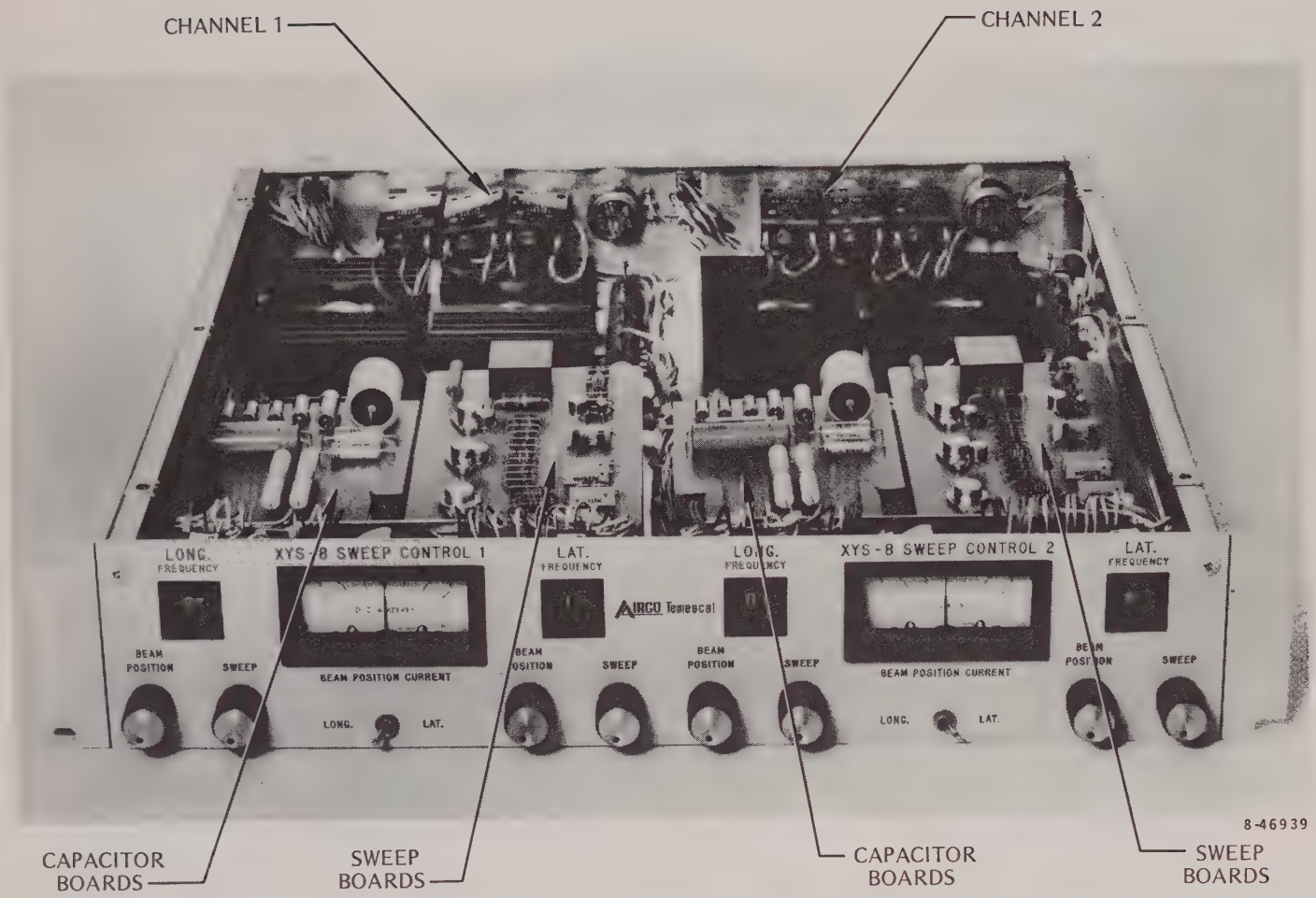

NOTE: TEST VOLTAGES ARE AS SHOWN WHEN MAIN POWER CIRCUIT BREAKER IS ON AND HIGH VOLTAGE IS OFF
TS1-SECTION 400 SERVICE LINKS FOR SECTION 1200
+ 75 VDC REFERENCE TO CHASSIS
+ 30V POSITIVE TO NEGATIVE
SEE FIGURE 3-5
+ 8.8 VDC REFERENCE TO CHASSIS
+ 10 VDC REFERENCE TO CHASSIS
+ 175 VDC REFERENCE TO CHASSIS
+ 115 VDC REFERENCE TO CHASSIS
SECTION 1000
CURRENT LIMIT ADJUST (FACTORY ADJUSTMENT)
LOW LIMIT VOLTAGE ADJUST (SET FOR 5 KV)
UPPER LIMIT VOLTAGE ADJUST (SET FOR 10.2 KV)
8-45625

Figure 6-1. CV-8 A and B power supply module, internal front view, service adjustment locations



ALL TOP BOARDS- LATERAL
ALL BOTTOM BOARDS- LONGITUDINAL

SEE ALSO FIGURE 3-3

Figure 6-2. XYS-8 service adjustment locations

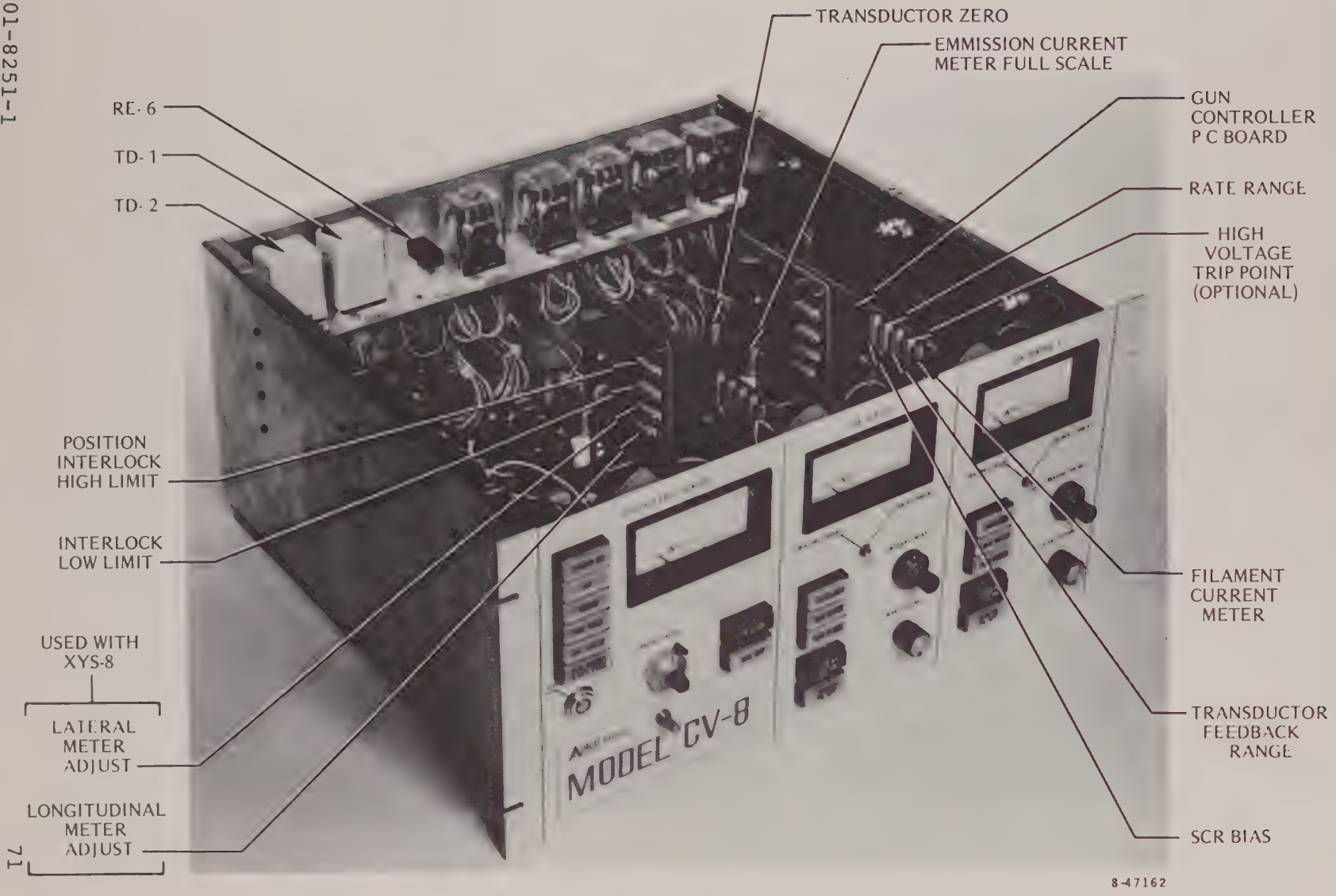


Figure 6-3. CV-8 A and B control module service adjustment locations

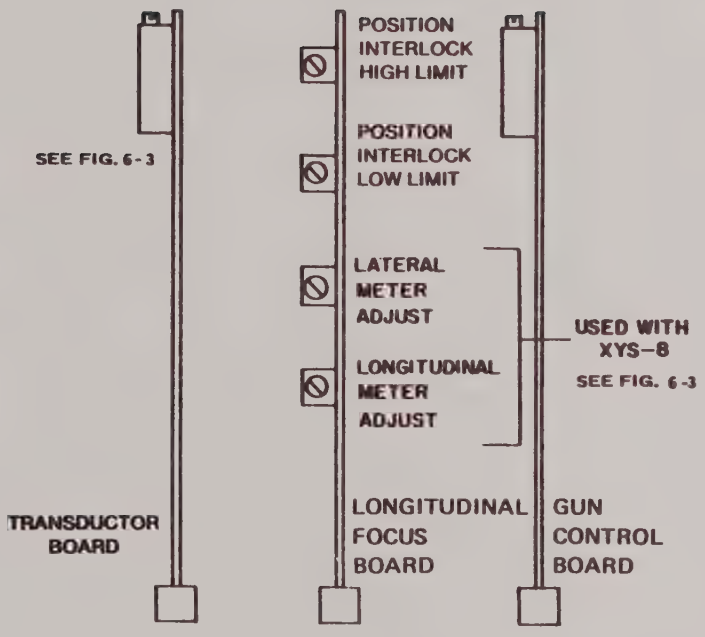


Figure 6-4. CV-8 A and B control module service adjustment locations

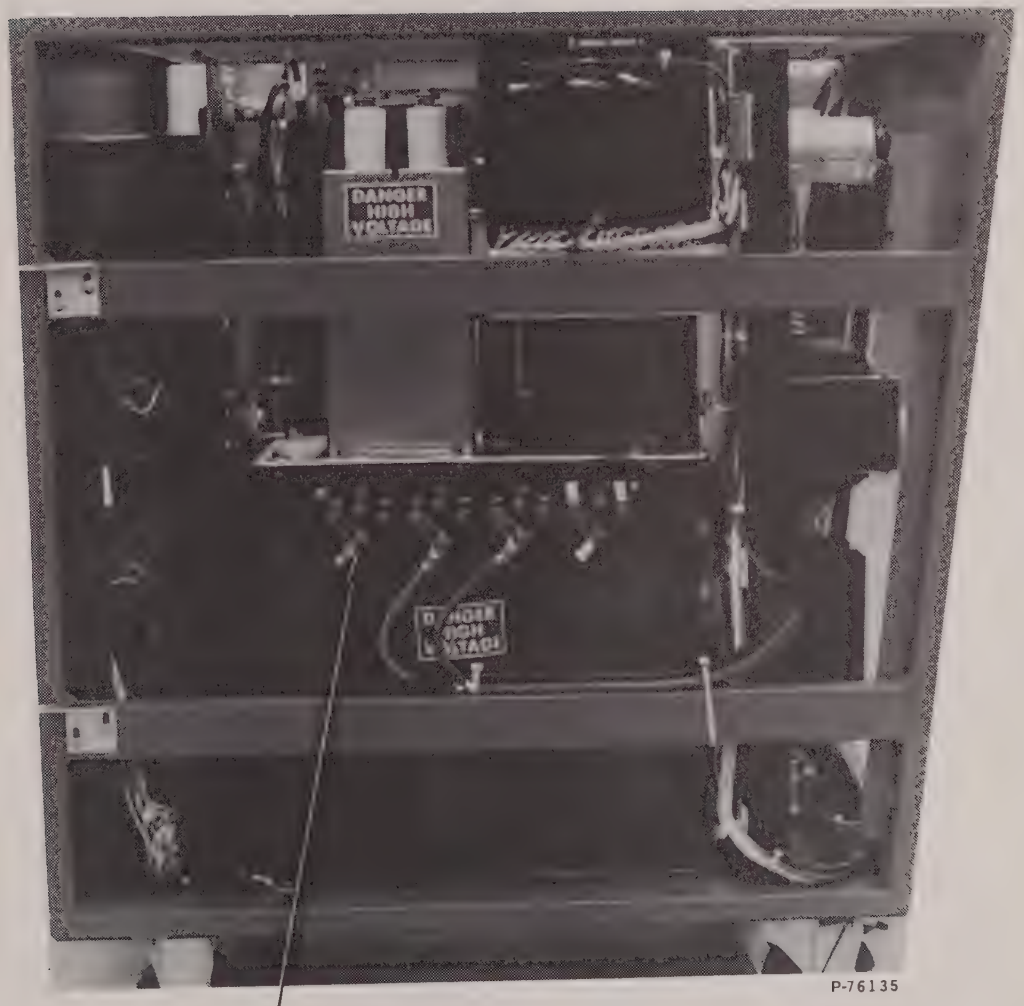


Figure 6-5. CV-8 A power supply module, internal left side view [Model B not illustrated. See schematic 506-0445 sheet 1 section]

CAUTION

Do not proceed with this adjustment unless current limiting is observed.

6) Turn the main power OFF. Short the high voltage to ground either in the power supply or at the vacuum tank. Turn the EMISSION CURRENT control fully counterclockwise (minimum).
7) Turn the main power and high voltage ON. The high voltage meter should read zero and the emission current meter should read about 0.7A.

NOTE

The HIGH VOLTAGE CONTROL circuitry will turn itself off after 20 seconds under these conditions. If the adjustment is not completed, turn the high voltage ON again.

8) Adjust 1000 R6 for 0.9A emission current.
9) Turn OFF the main power and remove the short installed in step 6.

6.1.4 Gun Control Adjustments (Figures and)

a) EMISSION CURRENT METER FULL SCALE ADJUST R13 AND TRANSDUCTOR ZERO ADJUST R4

WARNING

During this adjustment the emission current will be measured by the voltage across the current sensing resistors 610 and R14. Do not put a meter in series with the high voltage cable.

1) With the power OFF, remove card 610 from its socket and measure the resistance across 610 and R14. It should be 1.25Ω.
2) Replace the card in its socket and connect a voltmeter across 610 and R14. Set the meter scale to read 1V. Do not touch the meter when the power is on. Adjust the emission current meter to zero using the adjustment screw on the front of the face.
3) Turn ON the power supply and the high voltage. The FIL. OFF (ready) light should be on.
4) Adjust the transductor zero adjust for a zero reading on the emission current meter.

WARNING

The following adjustment delivers over 8 kW to the crucible. Use extreme caution to prevent damage to the electron beam gun.

5) Turn the filament ON. Adjust the EMISSION CONTROL for a reading of 1V on the voltmeter connected across the current sensing resistors.
6) Adjust the emission current meter full scale adjust for a reading of 0.8A on the emission current meter.
7) Turn the filament OFF and recheck the zero meter.
8) Turn OFF the power supply and remove the meter.

b) TRANSDUCTOR FEEDBACK RANGE ADJUST, R29 (Figure 6-3)

WARNING

The following adjustment delivers over 8 kW to the crucible. Use extreme caution to prevent damage to the electron beam gun.

1) Turn ON the power supply, high voltage, and the filament.
2) Adjust the high voltage for 10 kV.
3) Turn the EMISSION CONTROL fully clockwise (maximum).
4) Adjust the transductor range for a reading of 0.8A on the emission current meter.

c) HIGH VOLTAGE TRIP POINT ADJUST, R31 (Figure 6-3)
Factory adjustment only.

d) SCR BIAS, R4
Adjust the SCR bias outlined in paragraph 4.3.1,g. Perform the following adjustments only if the above setting gives unsatisfactory results.
1) Turn the power supply, high voltage, and the filament ON. Turn the EMISSION CURRENT control fully counterclockwise (minimum).
2) Adjust the SCR bias until there is a slight reading on the emission current meter.
3) Back off the SCR bias until the emission current meter reads zero. The desired bias point is just under emitting temperature. Check to see where the filament ammeter reads. It will be near the left green line.
4) Check the emission current meter. It should read zero.

e) FILAMENT CURRENT METER ADJUST, R26 (Figure 6-3)
1) Adjust the SCR bias as outlined above.

2) Press the meter switch and adjust the filament current meter adjust so that the meter reads on the lower green line. The emission current control knob must be at the minimum setting.

6.1.5 Beam Position Control Adjustments (Figures 6-3 and 6-4)

a) INTERLOCK HIGH AND LOW LIMIT, R7 AND R14
   1) Connect a 5A direct current ammeter in series with the (longitudinal) focus coil minus lead.
   2) Adjust the interlock high limit so that the GUN FOCUS indicator on the GUN CONTROLLER turns off between 3 and 3.1A of focus current.
   3) Adjust the interlock low limit so that the GUN FOCUS indicator turns off between 0.5 and 0.6A of focus current.
   4) Check the high and low limits again.
   5) Turn OFF the power supply and disconnect the direct current ammeter from the focus coil lead.

6.1.6 Sweep Adjustments (Optional) (Figure 6-2)

a) FRONT PANEL CONTROLS
   1) R1: Longitudinal Beam Position Control
   2) R5: Lateral Beam Position Control
   3) R6: Lateral Sweep Amplitude Control
   4) R4: Longitudinal Sweep Amplitude Control
   5) Frequency Thumbwheel Switches: Position No. 1 is the minimum sweep frequency. Position zero is maximum frequency.

b) CHASSIS-MOUNTED POTENTIOMETERS
   1) R3 and R7: Maximum longitudinal focus current limit adjust. R3 is coarse adjust; R7, fine. Adjust to get 3A output, then reduce to the desired amount after adjusting longitudinal sweep P.C. board. Adjust so that when the front panel position knob is at 100% there is no more longitudinal coil current than is required.

c) LONGITUDINAL/LATERAL SWEEP P.C. BOARD MOUNTED POTENTIOMETERS
   1) R5, Symmetry: Put the scope from the cathode of CR1 to ground and adjust for a uniform triangle waveform, also maximum peak to peak amplitude. A 5V peak to peak gives a symmetrical waveform.
   2) R2, Maximum Gain: Effects the maximum amplitude of both longitudinal and lateral outputs and limits voltage available to drive coils. Works in conjunction with R12. To limit the maximum output to some level below 3A direct current, use R2 and R12 to reduce the two outputs.

3) R13, Zero Offset: Balances the operational amplifier and zero output when the position potentiometer is at zero. To adjust, put board in lateral sweep P.C. socket, put position knob in dead center (5 full turns from either the clockwise or counterclockwise position), and adjust R13 until the lateral meter reads zero. Adjust both the longitudinal and lateral sweep boards this way.

NOTE

In some circuits, R2 and R13 have been eliminated from the P.C. boards and will have no adjustments.

4) R12, Amplitude Limit: Works in conjunction with R2. Should be adjusted at the minimum sweep frequency: No. 1 position on the thumbwheel switch.
5) R34, Positive Current Output Clamp: R34 sets the current level at which the circuit goes into a current limiting mode in the positive direction. It should be adjusted so that maximum output is limited to +2.5 to 3A direct current. R34 works only on positive lateral output.
6) R35, Negative Current Output Clamp: Works the same as R34, but only in the negative half of the output waveform. Clamps longitudinal and lateral output.
7) R39, Zero: Replaces R13 in some models and adjusts the same way as R13, but is located in a different part of the circuit.

d) LONGITUDINAL FOCUS P.C. BOARD
1) R20 and R21: Factory adjusted meter calibration potentiometers.
2) R7, High Limit: Focus interlock adjust. Adjusts the level at which the gun will drop out if the focus current exceeds a certain level, as in a short circuit.
3) R14, Low Limit: Focus interlock adjust. Adjusts the level at which the gun will drop out if the focus current drops below a certain level, as in an open circuit. In installations having guns other than Airco Temescal SuperSources, R7 and R14 must be adjusted so that the beam is within the confines of the crucible, or the gun will drop out.

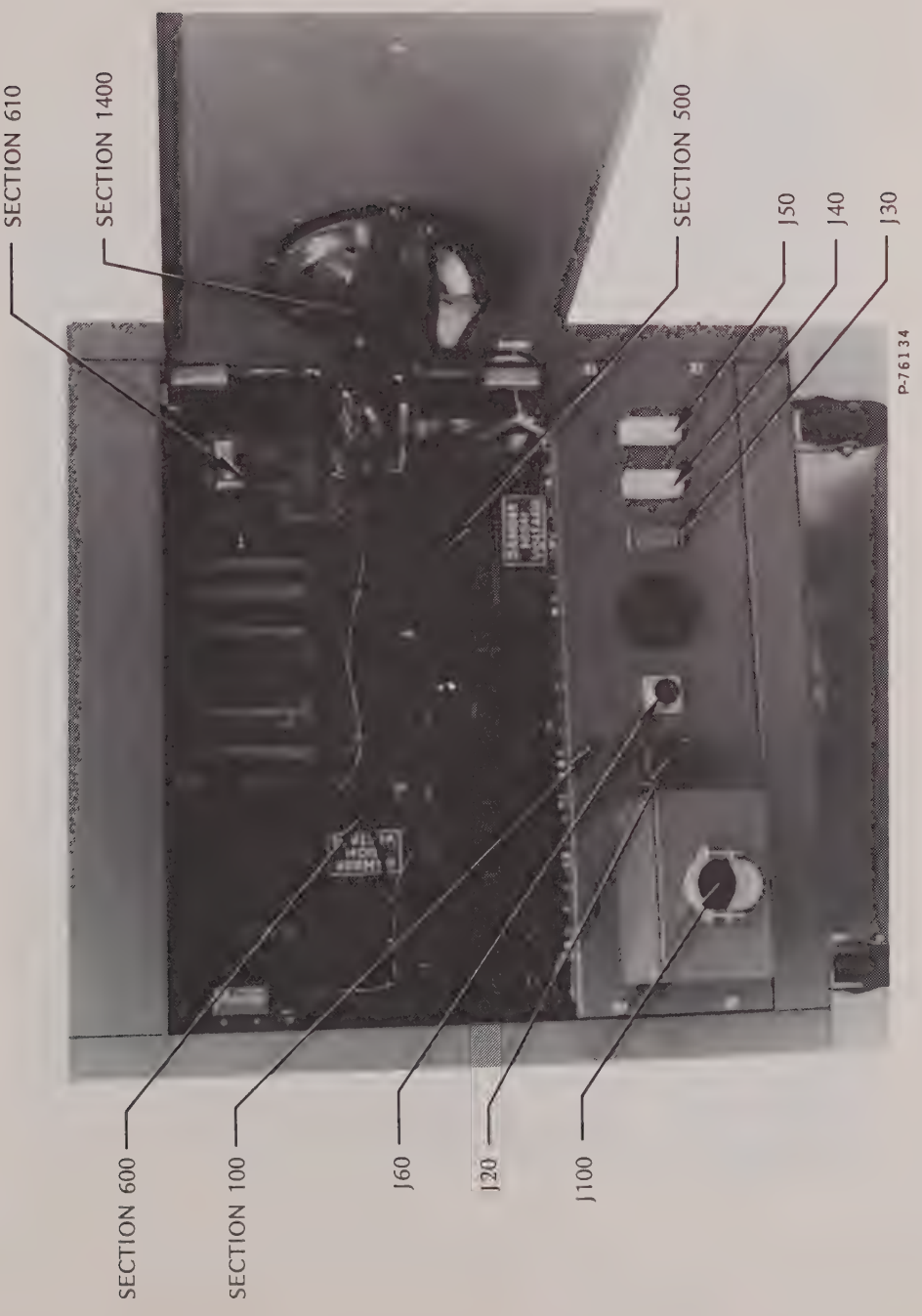


Figure 6-6. CV-8 A and B power supply module, internal rear view

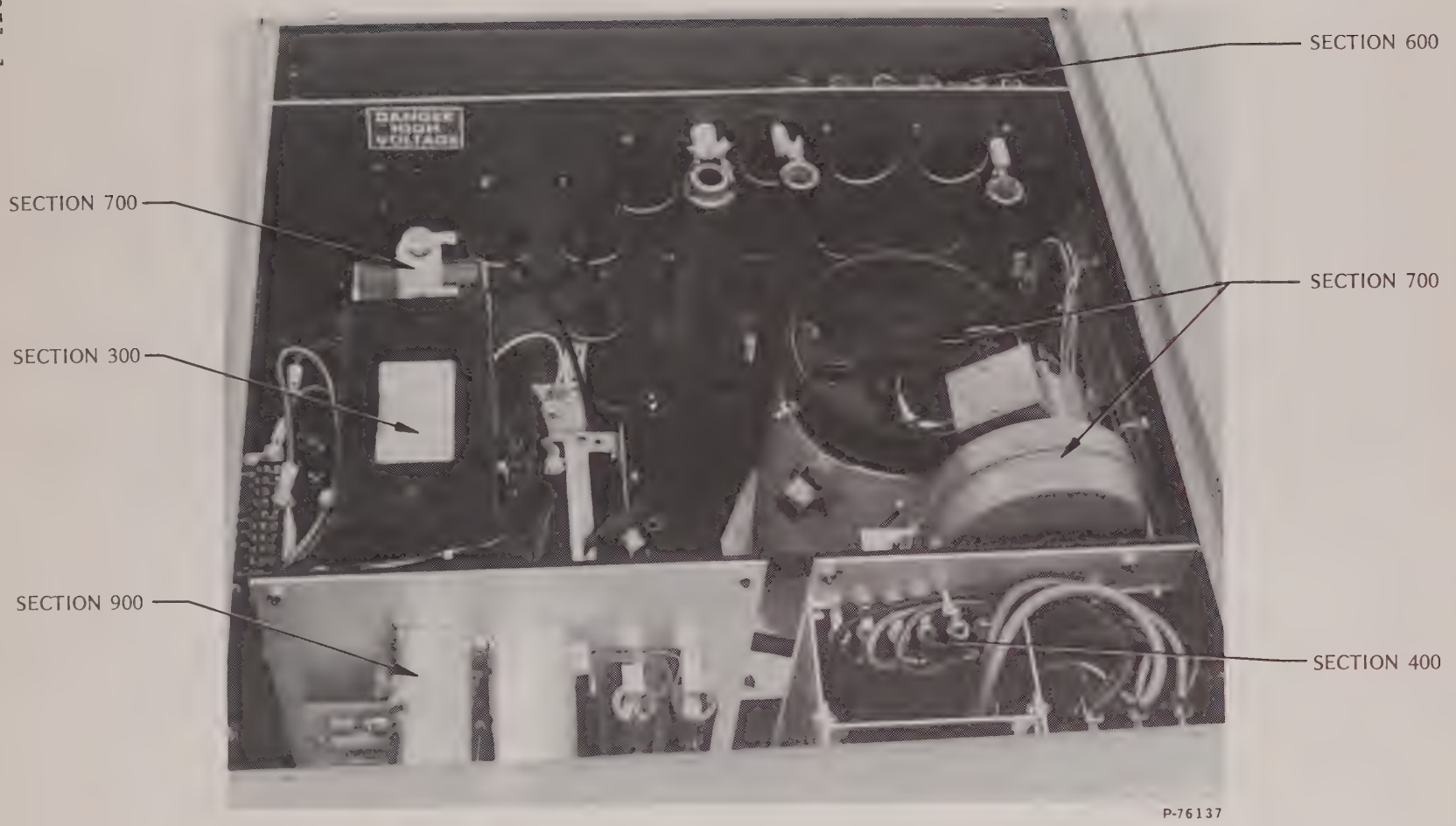


Figure 6-7. CV-8 A and B power supply module, internal top view

SECTION 7

TROUBESHOOTING

IMPORTANT
Read the high voltage safety precautions at the front of this manual.

Troubleshooting the CV-8 A and B power supplies should be done in a systematic manner. Use figures 4-1, 4-5, and 4-8 to help relate the difficulty to a particular circuit. Study section 5 to obtain a clear picture of circuit operation before troubleshooting.

In the event of an apparent primary power malfunction, ALWAYS check the interlock lights on the control module first. For example, if the DOORS, VAC TANK, VAC GAUGE, AND P.C. CARDS & KEY LOCK lights are off, but the other lights are ON, check the side and rear panels for proper installation. The succeeding interlock indicators will not be energized until the DOORS' interlock is satisfied.

Also check the circuit breaker panel for open circuit breakers. If a circuit breaker is open, reset it and proceed with normal operation. In a high power system, transients can trip circuit breakers when no actual malfunction exists. Assume trouble only if the circuit breaker will not stay on after three tries.

Another frequently overlooked source of trouble is the electron beam gun installation. Excessive arcing, loose connections, cracked or fouled insulators, and poor grounding all cause problems. If a high voltage problem develops, check the physical appearance of the feedthrough insulators. Also (with the high voltage OFF), check for tight connections.

If it is necessary to check the power supply module with the power on, the DOORS' interlock can be bypassed by pulling out the switch actuating rods. For safety, remove the key from the key lock and put it in your pocket while the power supply module is open. If high voltage measurements must be made (not recommended), turn off the power, connect the test instrument, and then turn the power on.

CAUTION
Do not, under any circumstances, touch the test meter or leads, or reach inside the power supply module with the high voltage on.

High voltage can arc over a considerable distance. It is not necessary to physically touch a live terminal to discharge the high voltage through your body.

Consistent failure of the supply or regulator circuits indicates radio frequency arcing problems. These can be corrected by installing a better grounding system. Refer to section 2, Installation, for details.

7.1 TROUBLESHOOTING CHART, MAJOR CIRCUITS

7.1.1 High Voltage Control Troubles

Symptom	Possible Cause	Remedy
1) All lights out	1) Service power; MAIN POWER CIRCUIT BREAKER module interconnecting cables; main control circuit breaker	1) Reset circuit breakers CB1 (section 200), CB2 (section 400), and CB1 in the control console.
2) Some interlock indicator lights out	2) Interlock indicated by top unlit light	2) The first interlock light in the control circuit which is not lit indicates that that interlock is not complete
3) H.V. OFF control ready light will not light when all the high voltage interlock lights are ON	3) H.V. OFF control PB1, time delay relay TD2, key lock are defective	3) Replace PB1, TD2, or key lock switch. These units can be tested with an ohmmeter providing all power is removed from the circuit
4) H.V. ON indicator will not come on or will not stay on. Ready light on	4) High voltage control relays RE5, RE6; high voltage latching relay RE2; H.V. ON control PB2	4) Check RE2 or PB2 located in high voltage control chassis. With power off, check RE2 coil or PB2 using an ohmmeter.
5) H.V. ON indicator illuminates but goes off in 20 seconds	5) Focus power supply (30V); high voltage control relays RE5, RE6; high voltage under 5 kV	5) Check 30V coming from longitudinal focus supply, sections 1110 and 1120, which operate RE5. Check 6V Zener diode CR10, section 610, which operates RE6 when the high voltage is on. Check RE5 and 6.

Symptom	Possible Cause	Remedy
6) H.V. ON indicator illuminates but the high voltage meter indicates zero or near zero. Emission ammeter reads zero	6) High voltage power supply circuit breaker CB1; high voltage power supply circuit; voltage divider circuit R10	6) Circuit breaker CB1 (section 400) is tripped. R6 (section 600) is open. High voltage meter is bad. R10 (section 600) is open. Contactors K1 and K2 (section 400) are not operating.
7) H.V. ON indicator illuminates but high voltage meter reads zero. Emission ammeter reads 0.8A	7) Shorted or fouled vacuum tank insulators; shorted high voltage cable; short in emitter assembly of gun	7) Disconnect filament leads from the secondary of the filament transformer for the electron beam gun. Make sure that they can't touch ground or the filament transformer. Then, turn on the high voltage. This will test the entire power supply and high voltage cable. If the voltage is clear, there is a short somewhere inside the tank.
8) FIL. ON, but no high voltage at gun; meter readings normal	8) Open high voltage cable; broken high voltage connection; resistor R17 in section 600 open.	8) Replace R17. Inspect both ends of high voltage cable.
9) No high voltage regulation; or high voltage low	9) Voltage regulator circuit; power triode circuit; bias power supply; caused by poor system ground	9) Q5 (section 1000) shorted. Check the filament leads on the tube socket for the triode tube. Check the bias supply voltages 185V, 10V, and 8.8V, on section 900
10) No high voltage regulation; voltage output high	10) Shorted power triode; voltage regulator circuit; voltage divider circuits; bias power supply; high	10) Voltage divider R7 (section 600) is open. Zener diode CR7 or CR8 (section 900) open. Grid is

Symptom	Possible Cause	Remedy
	voltage power supply	shorted to the cathode inside the triode tube. The grid connection to tube is open. Zener diodes CR7, CR8, CR9 are shorted. Filament leads to the tube are loose or oxydized.
11) MAIN POWER CIRCUIT BREAKER or high voltage circuit breaker trips repeatedly	11) Voltage regulator (current control) circuits; high voltage power supply	11) Triode tube is shorted internally. Q5 (section 1000) is bad. High voltage leads on section 500 or 600 are arcing to ground.

7.1.2 Emission Control Troubles

1) FIL. OFF (ready) light will not illuminate; all GUN CONTROL interlock lights on	1) FIL. OFF control (PB3, PB5)	1) Replace PB3 or PB5 on control console.
2) FIL. ON will not light or will not stay on. Ready light on.	2) FIL. ON control (PB4, PB6); filament control latching relay (RE3, RE4)	2) Replace PB4 or PB6, RE3 or RE4 on control console
3) No emission current; filament dark; no indication on filament current meter; FIL. ON light on	3) Open filament or connecting wires; filament transformer or connections, SCR's or driver circuits; GUN CONTROL power supply circuit breakers (CB5 and CB7, CB6 and CB9); GUN CONTROL power supply, section 1210, 1220	3) Replace filament. Check connections from filament transformer to gun. Check for 40V ac coming from section 1210, 1220. Replace Q1, Q2, or Q7 on gun control PC board
4) No emission current; filament dark; high current indication on filament current meter	4) Shorted filament or connecting wires; filament transformer; high voltage cable	4) Check filament, cathode blocks, beam former and its insulator for a shorting condition

Symptom	Possible Cause	Remedy
5) No emission current indication; filament lit but no visible beam; filament current meter indication normal	5) No high voltage at tank; GUN CONTROL circuits; LOCAL/REMOTE switch SW3/SW6 in wrong position; voltage divider circuit R10 (section 600)	5) Check SW3 or SW6. Voltage divider R10 is open on gun control PC board, Q6 bad, or Q4 bad. If in local control, Zener diode CR10 bad or emission control potentiometer bad. In remote control check output of rate controller.
6) Poor or no emission current regulation; current in normal range	6) SCR bias adjusted too high; transductor circuits; GUN CONTROL circuits	6) Refer to paragraph 6.1.4,d for proper bias adjustment. The gun filament could be installed backwards. If emission current jumps severely with only slight increase of current adjust control, transductor leads are open, Q1 and Q2 on transductor amplifier PC board are bad. If, when gun arcs, emission current jumps to maximum, Q6 on the gun control PC board is bad.
7) No emission current indication; visible beam	7) Transductor circuits; defective meter or switch	7) SW4/SW7 or ME2/ME3 in high voltage control chassis are bad. Check with ohmmeter. Check output of transductor amplifier PC board on Pin A. Voltage signal should be 0-6V (positive to ground), with 0-0.8A through transductor window.

Symptom	Possible Cause	Remedy
8) Emission current indication reversed or erratic	8) Transductor circuits	8) Check wiring or transductor. Refer to drawings 506-0365 and [506-0445]. On the transductor amplifier PC board, check the diodes CR1, CR2, CR3 and CR4 with ohmmeter.
9) GUN CONTROL circuit breaker(s) trips	9) Shorted SCR: shorted filament; filament transformer	9) If filament lights, SCR's CR2/CR3 or CR5/CR6 are shorted, or are being turned full on. Remove the gun control PC board. If the filament ammeter pegs, replace one or both SCR's. If not, Q1, Q2, or Q7 on the PC board is bad. If the filament stays dark, the filament or emitter assembly of the gun is shorting; the filament leads are breaking down; or the windings of the filament transformer have shorted.

7.1.3 Beam Position (Focus) Troubles

1) Beam not centered laterally	1) Gun out of alignment; magnetic interference from second gun	1) Check the instruction manual for the electron beam gun filament, beam former, anode, or whole emitter assembly. Check continuity of focus coils. Both the longitudinal and lateral coils should have infinite resistance in respect to each other, and to ground. If there

Symptom	Possible Cause	Remedy
		is a second electron beam gun in the same vacuum chamber, consult service department at the factory.
2) Beam cannot be located; all other conditions normal	2) Focus coil connections reversed; permanent magnet reversed.	2) If it is a permanent magnet type gun, the permanent magnet has been installed backwards. If, not, the focus coil leads are reversed.
3) No current indication into longitudinal coil	3) Circuit breaker (CB8, CB10); power supply circuit breaker (CB2, CB4); beam position power supply, section 1210, 1220; open focus coil or connections; beam position circuits; poor tank ground connection	3) Reset circuit breakers CB2, CB4, CB8, or CB10. Check the continuity of the focus coil. Resistance should be nominally 1.8Ω. The coil should not be grounded internally, nor should it have continuity with the lateral coil. NORMAL/XYS switch SW8/SW9 are in wrong position. On the longitudinal focus PC board, Q1, Q2, or Q3 is bad.
4) GUN FOCUS interlock off	4) Shorted or open focus coil or connections; beam position interlock circuit; beam position maladjusted	4) Check the focus coil as explained in previous symptom. On the longitudinal focus PC board, Q6 is bad if the high limit is faulty, Q4 is bad if the low limit is faulty. If neither limit works, Q7 or RE1 is bad. Check the coil of RE1.
5) GUN FOCUS interlock will not turn off under normal conditions	5) NORMAL-SS switch (SW2/SW5) in wrong position; BEAM POSITION interlock circuit	5) Replace Q7 or RE1 on the longitudinal focus PC board. Check the position of SW2 or SW5.

Symptom	Possible Cause	Remedy
7.1.4 Sweep Troubles		
1) No longitudinal sweep, position control normal	1) Position-sweep switch SW8/SW9 in wrong position; longitudinal sweep power supply, section 1110, 1120; longitudinal sweep circuits	1) Try the lateral sweep PC board in the longitudinal position. Check the longitudinal sweep power supply, section 1110, 1120, for plus and for minus for both 48V and 15V.
2) Longitudinal ammeter full scale, beam will not sweep	2) Output transistor, sweep PC board	2) Q1, located in high voltage control chassis, shorted; may have been caused by focus coil leads getting too close to the high voltage filament leads. On sweep PC board, check amplifier A1 (SQ-10A): Q7 (40343), Q8 (2N3498), Q9 (2N3441).
3) No longitudinal sweep; beam position abnormal	3) Longitudinal sweep circuits; longitudinal sweep power supply (see beam position [focus] troubles)	3) Check 30V coming from the longitudinal power supply in section 1210 or 1220. Check for plus and for minus for both 15V and 48V coming from section 1110 and 1120. Check continuity of focus coil at the feedthroughs. It should be nominally 1.8Ω referenced to ground. If the lateral sweep circuit is functioning properly, exchange PC boards to establish whether the problem lies in the PC board or not. If the circuit works normally using the lateral PC board,

Symptom	Probable Cause	Remedy
		check the waveform generator Q1, Q2, Q3, and CR1, by looking from cathode of CR1 to ground with an oscilloscope. You should see a triangular waveform which measures approximately 5V, peak to peak. If there is no triangular waveform, replace Q1, Q2, or Q3. If the waveform is normal, look at the cathode of CR2 to ground. If the waveform is not there, replace A1. If the waveform is there, replace Q7.
4) Lateral ammeter pegs left, then right. CB1, CB2, CB3 on rear of sweep trip	4) Output transistors, sweep PC board	4) Output transistors Q1 (2N3055), Q2 (2N3792) in the sweep chassis shorted. Q5 (2n3494), Q6 (2N3741), Q8 (2N3498), or Q9 (2N3441) on the sweep PC board shorted.
5) No lateral sweep and/or position control	5) Lateral focus coil or connections; lateral sweep circuits; lateral sweep power supply	5) Check continuity of the lateral coil at the feedthrough. Resistance should be nominally 3.8Ω. Coils should not be grounded inside the tank. Check plus and minus 48V and plus and minus 15V in the sweep power supply, section 1110, 1120. Check the waveform generator on the sweep PC board, Q1 (2N3251), Q2 (2N2925), and Q3 (2N1671). Check the

Symptom	Probable Cause	Remedy
		circuit breakers CB1, CB2, and CB3, on the back of the sweep control chassis.
6) Beam spot size increases on sweep	6) Normal condition	

SECTION 8

PARTS LISTS

8.1 SPARE PARTS KIT, BASIC (0505-2000-0)

Description	Qty.	Part Number
Diode Bridge, 1R, 18DB6A	1	6842-8193-0
Diode Bridge, MDA952-2	1	6842-3892-0
Diode, IR 10D8	3	6838-9410-0
Diode, Zener, 1N3322B	3	6813-3222-0
Diode, Zener, Motorola 1N750	1	6810-7500-0
Diode, Zener, Motorola 1N4740	1	6814-7400-0
Diode, Zener, Motorola 1N4722	1	6814-7220-0
Diode, Zener, 1N2974B	1	6812-9742-0
Diode, Zener, 1N4297	1	6814-2970-0
Diode, Zener, ST VR6B	1	6847-0062-0
Diode, Zener, 1N5341A	1	6815-3411-0
Diode, Zener, 1N4741A	1	6814-7411-0
SCR, Westinghouse 2N1847	2	6821-8470-0
Transistor, 2N3054	1	6823-0540-0
Transistor, 2N3904	3	6823-9040-0
Transistor, 2N3906	2	6823-9060-0
Transistor, 2N4402	1	6824-4020-0
Transistor, DTS-432	1	6840-9423-0
Transistor, RCA 40250	1	6842-7126-0
Transistor, GE 2N2925	1	6822-9250-0
Transistor, 2N3055	1	6823-0550-0
Transistor, RCA 2N697	1	6820-6970-0
Transistor, GE 2N2646	1	6822-6460-0
Transistor, RCA 40349	1	6840-3490-0
Transistor, T.I. 2N3703	1	6823-7030-0
Circuit Breaker, 15A, 250V ac, ETA 45-700-P	1	6157-1571-0
Circuit Breaker, 10A, 250V ac, ETA 45-700-P	1	6157-8700-0
Circuit Breaker, 5A, 250V ac, ETA 45-700-P	1	6157-1574-0
Circuit Breaker, 3A, 250V ac, ETA 45-700-P	1	6157-1576-0
Relay, 120V ac, P&B KUP-14A15	1	6041-4993-0
Resistor, 250 kΩ, 50W, Ohmite 0428	1	6469-4702-0
Installation tool for Clarodial	1	6990-0017-0

8.2 SPARE PARTS KIT, DELUXE (0408-5950-1)

Description	Qty.	Part Number
Diode Bridge, 1R, 18DB6A	1	6842-8193-0
Diode Bridge, MDA952-2	1	6842-3892-0

Description	Qty.	Part Number
Diode, IR 10D8	5	6838-9410-0
Diode, Zener, 1N3322B	3	6813-3222-0
Diode, Zener, Motorola 1N750	1	6810-7500-0
Diode, Zener, Motorola 1N4740	1	6814-7400-0
Diode, Zener, Motorola 1N4722	1	6814-7220-0
Diode, Zener 1N2974B	1	6812-9742-0
Diode, Zener 1N4297	1	6814-2970-0
Diode, Zener, ST VR6B	1	6847-0062-0
Diode, Zener 1N5341A	1	6815-3411-0
Diode, Zener 1N4741A	1	6814-7411-0
SCR, Westinghouse 2N1847	2	6821-8470-0
Transistor, 2N3054	1	6823-0540-0
Transistor, 2N3904	3	6823-9040-0
Transistor, 2N3906	2	6823-9060-0
Transistor, 2N4402	1	6824-4020-0
Transistor, DTS-423	1	6840-9423-0
Transistor, RCA 40250	1	6842-7126-0
Transistor, GE 2N2925	1	6822-9250-0
Transistor, 2N3055	1	6823-0550-0
Transistor, RCA 2N697	1	6820-6970-0
Transistor, GE 2N2646	1	6822-6460-0
Transistor, RCA 40349	1	6840-3490-0
Transistor, T.I. 2N3703	1	6823-7030-0
Circuit Breaker, 15A, 250V ac, ETA 45-700-P	1	6157-1571-0
Circuit Breaker, 10A, 250V ac, ETA 45-700-P	1	6157-8700-0
Circuit Breaker, 5A, 250V ac, ETA 45-700-P	1	6157-1574-0
Circuit Breaker, 3A, 250V ac, ETA 45-700-P	1	6157-1576-0
Relay, 120V ac, P&B KUP-14A15	2	6014-4993-0
Relay, Reed, Phipps PS894	1	0306-0362-0
Relay, 24V dc, P&B KUP-14D15	1	6041-4997-0
Relay, 0.2 sec, P&B CUA-41-71004	1	6041-2704-0
Relay, 0-60 sec, P&B CUA-41-70060	1	6041-2760-0
Resistor, 250 kΩ, 50W, Ohmite 0428	1	6469-4702-0
Resistor, 10 MΩ, 5W, 1%, Dale DC-5	2	6409-4259-0
Resistor, 3 MΩ, 60W, DVY-1	1	6434-0425-1
PC Assembly, Electron Gun Controller	1	0408-0840-0
PC Assembly, Transductor Amplifier	1	0307-1300-6
PC Assembly, Longitudinal Focus	1	0407-3870-2
PC Assembly, Regulator	1	0305-7684-0
Installation tool for Clarodial	1	6990-0017-0

8.3 COMPLETE PARTS LISTS

8.3.1 Control Chassis Basic Assembly

Description	Qty.	Part Number
Meter (ME1), 0-1 mA dc, 0-15 kV dc, 3-1/2" General Electric 50-16711FAFA3JGL	1	6700-5029-0
Meter (ME2,3), 0-1 mA, 0-1.5A dc, 3-1/2", General Electric 50-16711FAFA3JGM	2	6700-5030-0
Light (LT1), White, POWER ON, 125V ac, Molex	1	0408-0992-1
Light (LT2), White, AIR, 125V ac, Molex	1	0408-0992-4
Light (LT3), White, DOORS, 125V ac, Molex	1	0408-0992-3
Light (LT4), White, VAC TANK, 125V ac, Molex	1	0408-0992-6
Light (LT5), White, VAC GAUGE, 125V ac, Molex	1	0408-1002-7
Light (LT6), White, PC CARDS & KEY LOCK, 125V ac, Molex	1	0408-0992-5
Light (LT7,10), White, AUXILIARY, 125V ac, Molex	2	0408-0992-8
Light (LT8,11), White, GUN WATER, 125V ac, Molex	2	0408-0992-7
Light (LT9,12), White, FOCUS, 125V ac, Molex	2	0408-0992-9
Pushbutton (PB1), White, H.V. OFF, Molex 1825	1	0408-1012-1
Pushbutton (PB2), Red, H.V. ON, Molex 1825	1	0408-1022-1
Pushbutton (PB3), White, (Gun No. 1) FIL. OFF, Molex 1825	1	0408-1012-2
Pushbutton (PB4), Red, (Gun No. 1) FIL. ON, Molex 1825	1	0408-1022-2
Pushbutton (PB5), White, (Gun No. 2) FIL. OFF, Molex 1825	1	0408-1012-3
Pushbutton (PB6), Red, (Gun No. 2) FIL. ON, Molex 1825	1	0408-1022-3
Potentiometer (R1), 5-Turn, 100Ω, Bourns 3520-S1-101	1	6046-7810-1
Potentiometer (R6,14), 5-Turn, 1 kΩ, Bourns 3520-S1-102	2	6046-7810-2
Potentiometer (R10,18), 1 kΩ, 2W, Ohmite CMU1021	2	6046-1616-0
Knob (For R10,18), Raytheon DS-70-2BD-2G	2	6707-4105-6
Switch (SW1), Ace Lock 4073-1	1	6156-1504-0
Switch (SW4,7), DP/DT, Momentary, C&K 7208	2	6156-7208-0
Switch (SW2,5), DP/DT, C&K 7201	2	6156-7201-0
Switch (SW3,6), SP/DT, C&K 7101	2	6156-7101-1
Circuit Breaker (CB1), 15A, 250V ac, ETA 45-700-P	1	6156-1571-0
Circuit Breaker (CB3), 10A, 250V ac, ETA 45-700-P	1	6157-8700-0
Circuit Breaker (CB2,4,5,6,7,9), 5A, 250V ac, ETA 45-700-P	6	6157-1574-0
Circuit Breaker (CB8,10), 3A, 250V ac, ETA 45-700-P	2	6157-1576-0

Description	Qty.	Part Number
Relay, Reed (RE6), Phipps PS-894	1	0306-0362-0
Relay (RE1,2,3,4), 120V ac, P&B KUP14A15	4	6041-4993-0
Relay (RE5), 24V dc, P&B KUP14D15	1	6041-4997-0
Relay, Time Delay (TD1), 0.2 sec, P&B CUA41-71004	1	6041-2704-0
Relay, Time Delay (TD2), 0-60 sec, P&B CUF41-70060	1	6041-2760-0
Resistor (R2), 330 kΩ, 1/2W, 5%	1	6405-4705-0
Resistor (R5,13), 3 kΩ, 1/2W, 5%	2	6405-4635-0
Resistor (R4,12), 10Ω, 2W, 5%	2	6407-4561-0
Resistor (R3,7,9,11,15,17), 1Ω, 25W, Ohmite 0200J	6	6468-4530-0
Resistor (R8,16), 10Ω, 50W, Ohmite 0400B	2	6469-4561-0
Capacitor (C2,3,5,6), 0.047 mfd, 200V, Mylar, TRW X663F	4	6517-1932-0
Capacitor (C1,4), 0.1 mfd, 600V, Mylar, TRW X663F	2	6517-1971-0
Terminal, USECO 1601A	2	6047-3632-0
Diode Bridge (CR1,4), 600V, 1.8A, I-R 18DB6A	2	6842-8193-0
SCR (CR2,3,5,6), with hardware, Westinghouse 2N1847	4	6821-8470-0
Transistor (Q1,2), 2N3055	2	6823-0550-0
Choke (L1,2), Ohmite Z-20	2	6054-5020-0
Switch (SW8,9), 3P/DT, Toggle, C-H 37615K5	2	6156-4761-0
Bulkhead Receptacle (J4,5), BNC, Kings KC-74-12	2	6047-4472-0
Connector (J1), Winchester MRAC-34P	1	6047-8059-0
Connector (J2,3), Winchester MRAC-34S	2	6047-8061-0
Connector (J6,7), Winchester MRAC-26S	2	6047-8057-0
Receptacle (PC1J1,PC4J1), 22-Pin, Amphenol 225-22221-101	2	6047-2344-0
Receptacle (PC2J1,PC5J1), 15-Pin, Amphenol 225-21531-101	2	6047-2381-0
Receptacle (PC3J1,PC6J1), 15-Pin, Amphenol 143-015-01-110	2	6047-0050-1

8.3.2 Electron Gun Controller PC Assembly

Description	Qty.	Part Number
Capacitor (C3), 1 mfd, 25V, Sprague TE1200	1	6513-0847-0
Capacitor (C2), 10 mfd, 50V, Sprague TE1304	1	6505-1789-0
Capacitor (C1), 1 mfd, 200V, Mylar, TRW X663F	1	6517-1933-0
Capacitor (C9), 0.01 mfd, 100V, Ceramic, Erie Z5U	1	6590-0002-0
Capacitor (C5), 0.047 mfd, 200V, TRW X663F	1	6517-1932-0

Description	Qty.	Part Number
Capacitor (C4,7), 50 mfd, 50V, Sprague TE1307	2	6513-0865-0
Capacitor (C6), 0.1 mfd, 100V, Ceramic, Sprague TG-P10	1	6504-5999-0
Capacitor (C10), 4 mfd, 50V, Sprague TE1302.1	1	6513-1257-0
Diode (CR2), Zener, 4.7V, Motorola 1N750	1	6810-7500-0
Rectifier Bridge (C6), 600 PRV, 1.8A, I-R 18D B6A	1	6840-8193-0
Diode (CR3), Zener, 10V, 1W, 10%, Motorola 1N4740	1	6814-7400-0
Diode (CR1,4,5,7,8,9,10), 800V, I-R 10D8	7	6838-9410-0
Transistor (Q1), RCA 2N697	1	6820-6070-0
Transistor (Q5,6,7), Motorola 2N3904	3	6823-9040-0
Transistor (Q3,8), Motorola 2N3906	2	6823-9060-0
Transistor (Q2), Unijunction, General Electric 2N2646	1	6822-6460-0
Transistor (Q4), RCA 40349	1	6840-3490-0
Transformer (T1), Gudeman G-4017	1	6054-4017-0
Relay (K1), Phipps PS-894	1	0306-0362-0
Potentiometer (R4), 250 kΩ, 3/4W, Beckman 89PR250K Helitrim	1	6046-8825-1
Potentiometer (R29), 1 kΩ, 3/4W, Beckman 89PR1K Helitrim	1	6046-8701-1
Potentiometer (R31,32), 10 kΩ, 3/4W, Beckman 89PR10K Helitrim	2	6046-8710-1
Potentiometer (R26), 2 kΩ, 3/4W, Beckman 89PR2K Helitrim	1	6046-8702-1
Choke (L1), 1 mH, Nytronic 1000	1	6831-0112-0
Resistor (R9,28), 680Ω, 1/2W, 5%	2	6405-4616-0
Resistor (R3), 1 kΩ, 1/2W, 5%	1	6405-4623-0
Resistor (R13), 220Ω, 1/2W, 5%	1	6405-4600-0
Resistor (R1,2) 470Ω, 1/2W, 5%	2	6405-4579-0
Resistor (R10), 47 kΩ, 1/2W, 5%	1	6405-4675-0
Resistor (R5,20), 100 kΩ, 1/2W, 5%	2	6405-4690-0
Resistor (R17), 6.8 kΩ, 1/2W, 5%	1	6405-4647-0
Resistor (R15), 330Ω, 2W, 5%	1	6407-4605-0
Resistor (R25,30), 330Ω, 1/2W, 5%	2	6406-8710-1
Resistor (R6,8,22), 15 kΩ, 1/2W, 5%	3	6405-4658-0
Resistor (R11,23), 470Ω, 1/2W, 5%	2	6405-4610-0
Resistor (R18,21), 390Ω, 1/2W, 5%	2	6405-4607-0
Resistor (R19), 150 kΩ, 1/2W, 5%	1	6405-4695-0
Resistor (R7), 7.5 kΩ, 1/2W, 5%	1	6405-4699-0
Resistor (R12,16), 4.7 kΩ, 1/2W, 5%	2	6405-4641-0
Resistor (R14), 1.2 kΩ, 1/2W, 5%	1	6405-4625-0
Resistor (R31), 10 kΩ, 1/2W, 5%	1	6405-4654-0

8.3.3 Transductor Amplifier PC Assembly

Description	Qty.	Part Number
Transformer (T1), F&R 2T18	1	0206-4041-0
Diode Bridge (CR5), 1.8A, 600V, I-R 18DB6A	1	6842-8193-0
Diode (CR1,2,6), 1A, 800V, I-R 10D8	3	6838-9410-0
Diode (CR3,4), Zener, 11V, 1W, Motorola 1N4741A	2	6814-7411-0
Transistor (Q1), TI 2N3703	1	6823-7030-0
Transistor (Q2), General Electric 2N2925	1	6822-9250-0
Capacitor (C1,2), 100 mfd, 25V, Sprague TE1211	2	6513-0856-0
Capacitor (C3), 0.47 mfd, 100V, TRW X663F	1	6517-1906-0
Potentiometer (R4), 2 kΩ, Beckman 89PR2K	1	6046-8702-1
Potentiometer (R13), 5 kΩ, Beckman 89PR5K	1	6046-8705-1
Resistor (R7), 100Ω, 1/2W, 5%	1	6405-4592-0
Resistor (R1), 300Ω, 1/2W, 5%	1	6405-4604-0
Resistor (R2), 390Ω, 1/2W, 5%	1	6405-4607-0
Resistor (R11), 1 kΩ, 1/2W, 5%	1	6405-4623-0
Resistor (R3), 2 kΩ, 1/2W, 5%	1	6405-4630-0
Resistor (R12), 5.1 kΩ, 1/2W, 5%	1	6405-4643-0
Resistor (R10), 12 kΩ, 1/2W, 5%	1	6405-4656-0
Resistor (R8), 18 kΩ, 1/2W, 5%	1	6405-4660-0
Resistor (R6,9), 20 kΩ, 1/2W, 5%	2	6405-4661-0

8.3.4 Longitudinal Focus PC Assembly

Description	Qty.	Part Number
Transistor (Q3), 2N3054	1	6823-0540-0
Transistor (Q1,4,6), 2N3904	3	6823-9040-0
Transistor (Q2,5), 2N3906	2	6823-9060-0
Transistor (Q7), 2N4402	1	6824-4020-0
Capacitor (C1,2), 0.05 mfd, 50V, Ceramic	2	6503-1647-0
Diode (CR5), Zener, 6.2V, 5W, 1N5341A	1	6815-3411-0
Diode (CR1,2,3,4,6,7), 1W, 800V, I-R 10D8	6	6838-9410-0
Potentiometer (R7,14), 200Ω, Beckman 89PR200	2	6046-8620-1
Potentiometer (R20,21), 2 kΩ, Beckman 89PR2K	2	6046-8702-1
Resistor (R18), 47Ω, 1/2W, 5%, Beckman 89PR2K	1	6405-4579-0
Resistor (R19), 75Ω, 1/2W, 5%	1	6405-4587-0
Resistor (R8,13), 200Ω, 1/2W, 5%	2	6405-4599-0
Resistor (R1), 390Ω, 5W, 5%, Ohmite 2884	1	6421-2884-0
Resistor (R16), 510Ω, 1/2W, 5%	1	6405-4612-0
Resistor (R12), 820Ω, 1/2W, 5%	1	6405-4620-0
Resistor (R2), 1 kΩ, 1/2W, 5%	1	6405-4623-0
Resistor (R3,11,15), 2 kΩ, 1/2W, 5%	3	6405-4630-0
Resistor (R6,22,23), 4.7 kΩ, 1/2W, 5%	3	6405-4641-0
Resistor (R5,10), 10 kΩ, 1/2W, 5%	2	6405-4654-0

Description	Qty.	Part Number
Resistor (R4,9), 22 kΩ, 1/2W, 5%	2	6405-4662-0
Resistor (R17), 1Ω, 20W, Ohmite 1802-A	1	6425-1802-0
Relay (RE1), DP/DT, 24V dc Coil, American Zettler AZ428-70-4H	1	6041-0428-7

8.3.5 Standard Cable Assemblies

Description	Qty.	Part Number
Tank Cable, 20-Foot	1	0506-1570-0
Channel Cable #1, 20-Foot	1	0407-7270-3
Channel Cable #2, 20-Foot	1	0407-7270-4
Control Cable, 20-Foot	1	0407-7280-1
High Voltage Cable #1, 20-Foot	1	0407-7290-1
High Voltage Cable #2, 20-Foot	1	0407-7290-2

8.3.6 Service Panel Assembly, Section 100

Description	Qty.	Part Number
Receptacle (J60), Amphenol MS-3102A-18-1S-C	1	6045-2242-0
Receptacle (J20), Amphenol 97-3102A-28-125	1	6045-2851-0
Connector (J30), Winchester MRAC-34S	1	6047-8061-0
Connector (J40,50) Winchester MRAC-34P	2	6047-8059-0

8.3.7 Main Circuit Breaker, Section 200

Description	Qty.	Part Number
Circuit Breaker (CB1), 50A, 3-Pole, 240V ac, Westinghouse EB3050	1	6157-4307-0
[Circuit Breaker (CB1,), 35A, 3-Pole, 480V ac Westinghouse EHB3035]	1	[6157-3035-0]

8.3.8 Control Transformer Assembly, Section 300

Description	Qty.	Part Number
Transformer (T1), 1.5 kVA, 50/60 Hz, Westinghouse 1F2881	1	6024-5190-0

8.3.9 Step-Start Assembly, Section 400

Description	Qty.	Part Number
Circuit Breaker (CB1), 40A, 3-Pole, 240V ac, Westinghouse HQC-3040	1	6157-4340-0
[Circuit Breaker (CB1), 25A, 3-Pole 480V ac Westinghouse EHB 3025]	1	[6157-3025-0]
Circuit Breaker (CB2), 5A, 2-Pole, 230V ac, Westinghouse QCL-2005	1	6157-0003-0
Contactor (K1), 110V, 3-Phase, 75A, 50/60 Hz, 600V ac, A-H ACC-630-V	1	6157-1506-0
Contactor (K2), 110V, 3-Phase, 40A, 50/60 Hz, 600V ac, A-H ACC-330-U	1	6157-1503-0
Resistor (R1,[2],3,[4],5,[6] 5Ω, 50W, Ohmite 0040A	6[3]	6469-4549-0
Terminal Strip (TS1), Kulka 671-10	1	6014-8048-0

8.3.10 High Voltage Transformer Assembly, Section 500

Description	Qty.	Part Number
Transformer (T1), H.V., 208/220/240V-Δ or 360/380/415-Y Primaries, 50/60 Hz, Airco Temescal 207-6353	1	0207-6353-0

8.3.11 High Voltage Rectifier Panel Assembly, Section 600

Description	Qty.	Part Number
Rectifier, H.V. (CR1,2,3,4,5,6), I-R 307-7293	6	0307-7293-0
Resistor (R6,17), 25Ω, 225W, Ohmite 0901	2	6472-4371-0
Resistor (R7x6), 250 kΩ, 50W, Ohmite 0428	6	6469-4702-0
Resistor (R8x6), 50 kΩ, 100W, Ohmite 0622	6	0470-4673-0
Resistor (R9x6,10x4), 10 MΩ, 5W, 1%, Dale DC-5	10	6409-4259-0
Resistor (R4), 3 MΩ, 60W, 15%, RPC DVY-1	1	6434-0425-0
Resistor (R5), 10Ω, 100W, Ohmite 0600B	1	6470-4561-0
Transductor (MT1), 2F4051	1	0206-4051-0
Terminal Strip (TS2,3), ETC 34004-3423	2	6044-3004-0

8.3.12 High Voltage Rectifier PC Assembly, Section 610

Description	Qty.	Part Number
Capacitor (C8), 0.01 mfd, 1 kV, CRL DD-103	1	6503-0339-0
Capacitor (C9), 1 mfd, 200V, TRW X663F	1	6517-1938-0
Resistor (R11), 20 kΩ, 10W, Ohmite 1765	1	6453-4654-0
Resistor (R12,16), 10 kΩ, 2W, 5%	2	6407-4654-0
Resistor (R14x2), 2.5Ω, 10W, Dale RS-10	2	6443-4039-0
Resistor (R13), 100 kΩ, 2W, 5%	1	6407-4690-0
Resistor (R15), 10Ω, 2W, 5%	1	6407-4561-0
Resistor (R18), 1 kΩ, 12W, Ohmite 1736	1	6453-4623-0
Diode (CR10), Zener, 6.2V, Sarkes Tarzian VR68	1	6847-0062-0

8.3.13 High Voltage Rectifier Assembly, Section 620

Description	Qty.	Part Number
Capacitor (C1,2,3,4,5,6), 0.005 mfd, 25 kV, Sprague 708C8	6	6505-9381-0
Resistor (R1,2,3), 50Ω, 50W, Non-Inductive, Ohmite 2004	3	6473-2004-0

8.3.14 Zener Diode Heat Sink Assembly, Section 630

Description	Qty.	Part Number
Diode (CR7,8,9), Zener, 25V, 50W, 1N3322B	3	6813-3222-0

8.3.15 Triode Plate Assembly, Section 700

Description	Qty.	Part Number
Transformer (T1), Tube Filament	1	0205-0153-0
Tube (V1), Triode, EIMAC 3CX10000AT	1	6921-0103-0
Capacitor (C4), 1 mfd, 15 kV, Plasticap LK-150-105	1	6505-9423-0
Capacitor (C2,3), 1 mfd, 200V, TRW X663F	2	6517-1938-0
Capacitor (C1), 1 mfd, 600V, TRW X663F	1	6517-1968-0
Resistor (R1), 10Ω, 10W, Non-Inductive, Sprague 457E1005	1	6473-2051-0
Fan (B1), Rotron 103	1	6260-0103-0
Blower (B2), Datron 1C-180	1	6271-3180-0
Switch (S2), Vane, Airflow, 5A, 250V ac, SP/DT, H.G. Dietz 103A	1	6156-4303-0
Switch (S1), Airflow, Fairchild PSF-100A	1	6156-4311-0

8.3.16 Bias Power Supply Assembly, Section 900

Description	Qty.	Part Number
Transformer (T1), Control, F&R 2F1101	1	0206-1101-0
Diode (CR7), Zener, 10V, 10W, 1N2974B	1	6812-9742-0
Diode (CR8), Zener, 8.8V, 10W, 1N4297	1	6814-2970-0
Diode (CR6), 3A, 440V, Motorola 1N4722	1	6814-7220-0
Capacitor (C1x2), 1250 mfd, 180V	2	6505-3019-0
Choke (L1), 0.3H, 3Ω, Stancor C-2690	1	6054-1137-0
Resistor (R1,2), 250Ω, 175W, Ohmite 0706	2	6465-4602-0
Resistor (R3), 5 kΩ, 12W, Ohmite 1749	1	6423-1749-0
Receptacle (J1), Winchester MRAC14P	1	6047-8045-0
Terminal Strip (TS1), ETC 34010-3423	1	6044-3008-0

8.3.17 Regulator PC Assembly, Section 1000

Description	Qty.	Part Number
Transistor (Q5), Delco DTS-423	1	6840-9423-0
Transistor (Q4), RCA 40250	1	6840-7126-0
Transistor (Q1,2,3), 2N2925	3	6822-9250-0
Diode (CR1,2,3), I-R 10D8	3	6838-9410-0
Capacitor (C1,2), 0.1 mfd, 200V, TRW X663F	2	6517-1933-0
Capacitor (C3), 0.1 mfd, 400V, TRW X663F	1	6517-1328-0
Potentiometer (R1,2), 200Ω, IRC 100-1	2	6046-2682-0
Potentiometer (R6), 10 kΩ, IRC 100-1	1	6046-1738-0
Resistor (R3,4,8,12,14), 100Ω, 1/2W	5	6405-4592-0
Resistor (R5,7,9,10), 1 kΩ, 1/2W	4	6405-4623-0
Resistor (R11), 4.7 kΩ, 1/2W	1	6405-4641-0
Resistor (R13), 8.2 kΩ, 1/2W	1	6405-4651-0
Resistor (R16), 20Ω, 1W	1	6406-4568-0
Resistor (R15), 20Ω, 2W	1	6407-4568-0
Resistor (R17), 2Ω, 11W, Ohmite 4737	1	6411-4537-0
Receptacle (J1), 15-Pin, Amphenol 225-21531-101	1	6047-2381-0

8.3.18 Lateral Focus and Beam Sweep Auxiliary Power Supply, Section 1110

Description	Qty.	Part Number
Transformer F49U	1	6054-2014-0
Capacitor 4500 mfd 50V CG-452U500-1	2	6505-8130-0
Capacitor Brkt Mallory VR8	2	6048-6008-0
Diode Bridge MDA 952-2	2	6842-3892-0
Heatsink Wakefield NC-680-1.25 Modification	2	0408-5792-0
Receptacle Winchester MRAC-14P	1	6047-8045-0
Diode Zener 1N2979B	2	6812-9792-0
Contact Winchester 100-0911P	8	6047-8023-1
Guide Set Winchester G-700	1	6047-8700-0
Resistor 6.8k 1/2W 5%	2	6405-4647-0
Metal Spacer 1/4-in hex x 1/2-in long x 6-32 Smith 2322	8	6040-2322-0
Fiber Washer Smith 2162	8	1083-2162-0
Nylon Screw 6-32 x 1/2-in	8	1042-1255-0
Terminal Strip Q.D. 6 PT ETC 34006-3423	1	6044-3006-0
15 Pin Printed Circuit Receptacle Amphenol 143-015-01	1	6047-0500-0
Metal Spacer 1/4-in o.d. x 1-in x 4-40 Smith 2374	4	6040-2374-0
Nylon Screw 6-32 x 1-in Long Black	4	1042-1259-0
Nylon Nut 6-32 Black	4	1060-1201-0
Bracket FAB Printed Circuit Card Support	1	0408-4553-0
Lateral Focus Printed Circuit Assembly 407-3173	1	0407-3170-0
Base Plate Fabrication PER 408-5684	1	0408-5684-0
Sweep Auxiliary Power Supply Assembly	1	0408-0320-1

8.3.19 Lateral Sweep Power Supply Printed Circuit Assembly, Section 1112

Description	Qty.	Part Number
Printed Circuit Board	1	0407-3163-0
Printed Circuit Capacitor 500 mfd 25V dc Sprague TVA-1209	2	6510-0159-0
Resistor 100Ω 25W DALE HL-25	2	6445-4372-0

8.3.20 Beam Sweep Control Auxiliary Power Supply Assembly, Section 2311

Description	Qty.	Part Number
Printed Circuit Board Assembly PER 408-1943	1	0408-1940-0
Heat Sink Mounting Plate	1	0408-1852-0
Resistor 200Ω 25W Ohmite No.0200H	2	6468-4599-0
Zener Diode 1N2979B	2	6812-9792-0
Heatsink NC-680-1.25 Modified	2	0408-5792-0
Metal Spacer 1/4 o.d. x 2-in long x 6-32 Smith No.8351	4	6040-8351-0
Metal Spacer 1/4 o.d. x 3/8 long x 6-32 Smith No.2121	4	6047-4765-0
Fiber Washer No.6	8	1083-2162-0
Nylon Screw No.6-32 x 1/2-in long	8	1042-1255-0
Nylon Nut 6-32	8	1060-1201-0
Contact Winchester 100-0915P	7	6047-8026-1

8.3.21 Beam Sweep Control Auxiliary Power Supply - Printed Circuit Board Assembly, Section 2320

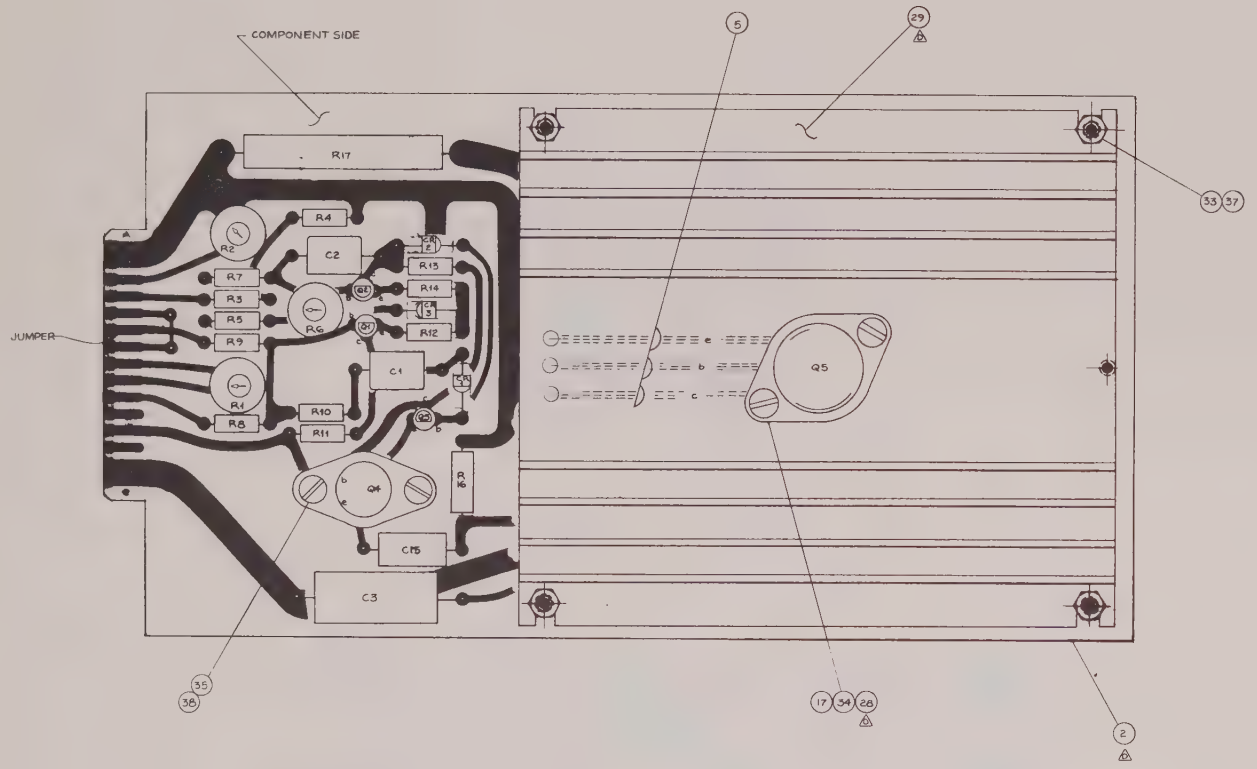
Description	Qty.	Part Number
Transformer Signal PC34-300	2	6054-0014-0
Resistor 6.8 kΩ 1/2W 5%	2	6405-4647-0
Diode Bridge 18DB6A	2	6842-8193-0
Capacitor 500 mfd 50V Sprague No.1315	2	6510-0975-0

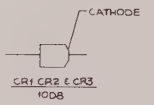
8.3.22 Longitudinal Focus Power Supply Assembly, Section 1210 and 1220

Description	Qty.	Part Number
Transformer (T1)	1	0206-5521-0
Diode Bridge (CR1), Motorola MDA952-2	1	6842-3892-0
Capacitor (C1), 2000 mfd, 50V dc, Mallory CG23U50C1	1	6505-8149-0
Receptacle (J1), Winchester MRAC-14P	1	6047-8045-0

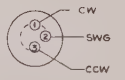
8.3.23 Door Interlocks and Fan, Section 1400

Description	Qty.	Part Number
Fan, Kooltronic KB6505	1	6260-2650-0
Switch (S1,2,3), Door, Microswitch 23AC1	3	6156-9230-0





CR1 CR2 & CR3
1OD8



R1 R2 & R6
(BOTTOM VIEW)

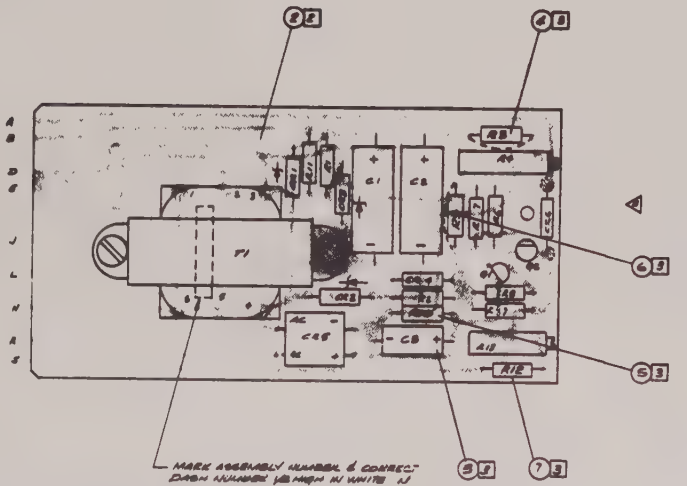
Q1 Q2 & Q3
(BOTTOM VIEW)
2N2925

NOTES:
1. REFERENCE DRAWINGS:
   ARTWORK DWG NO.-2E 8044
   FABRICATION DWG NO.-3E-7694
   SILKSCREEN NO-307-2073
   SCHEMATIC DWG NO-306-6135
   PART LIST NO.-3E-7684
2. FOR BALLOONED HARDWARE
   REFER TO PARTS LIST 0305-7684-0

DESCRIPTION	ITEM	PART NO.	SUB ASSY	QTY

REV.	DESCRIPTION	BY	DATE	APP'VD
UNLESS OTHERWISE SPECIFIED			USED ON DWG. NO	
BREAK ALL EDGES -.005 .015	INTER RADII .015 MAX		DO NOT SCALE DRAWING	
FINISH	TOLERANCE XXX ± .005 XX ± .02 X ± .1	CHAMFER ENDS OF ALL SCREW THREADS .10 X 45° THREADS CLASS 2	AIACO Temescal A DIVISION OF AIRCO INC. Berkeley, California	
DRAWN BY HILDA TURNER	DATE 2 2979	CHK BY	APP BY	SCALE 2:1
A-T STANDARD MODEL CV-10A & CV-8				DRAWING NUMBER
REGULATOR P.C. BOARD ASSEMBLY				3E 7684 C

PARTS LIST NO. APPLIES



307-1304 DASH NO. TABULATION

DASH NO	AMP RANGE	USED ON	USE A/M	NEXT ASSY	INSTALL ITEM NO				
					R9	R10	JUMPER	R12	C9
-0	1.2A FAST	FG-6A-1/10	307-1300-0	307-1124 ASSY	R9	R10	JUMPER	R12	C9
-1	1.2A SLOW	FGC-1/4 FGC-1/2 FGC-1	307-1300-1	307-4933-01 PRV. 2FB354-1/4 2AG. 2FB354-1/2 2AG.	R9	R10	JUMPER	R12	C9
-2	3.0A SLOW	AGC-6/10	307-1300-2	2AB354-3/4	JUMPER	R10	R9	R12	C9
-3	5.0A SLOW	SPECIAL	307-1300-3	2FB354-5 (1.)	JUMPER	R10	R9	R12	C9
-4	10.0A SLOW	SPECIAL	307-1300-4		JUMPER	R10	R9	R12	C9
-5	15.0A	SPECIAL	307-1300-5		JUMPER	R10	R9	R12	C9
-6	1.5A	CY-6/10	307-1300-6		R9	R10	JUMPER	R12	C9

NOTES: UNLESS OTHERWISE SPECIFIED

SCHEMATIC DWG NO 307-4933-SHT

TABULATION FOR DASH NO.

2 BASIC P.C. BOARD ASSY 90% COMPLETE

3 FOR INSTALLATION SEE TABULATION

REV	DWG NO	DESCRIPTION	DATE	BY
B		ADDED ITEM 7, NOTES 1 & 3 AND COMPONENTS ON BASIC BD.	6/78	ASH

SCC TABLE

SEMICONDUCTOR DIVISION — AIRCO TEMESCAL — CALIFORNIA

A DIVISION OF AIR REDUCTION COMPANY INCORPORATED

DRAWN 3/6/78 CHECKED 3/8/78 APPROVED

A-7 STANDARD

TRANSISTOR AMPLIFIER P.C. BD ASS'Y

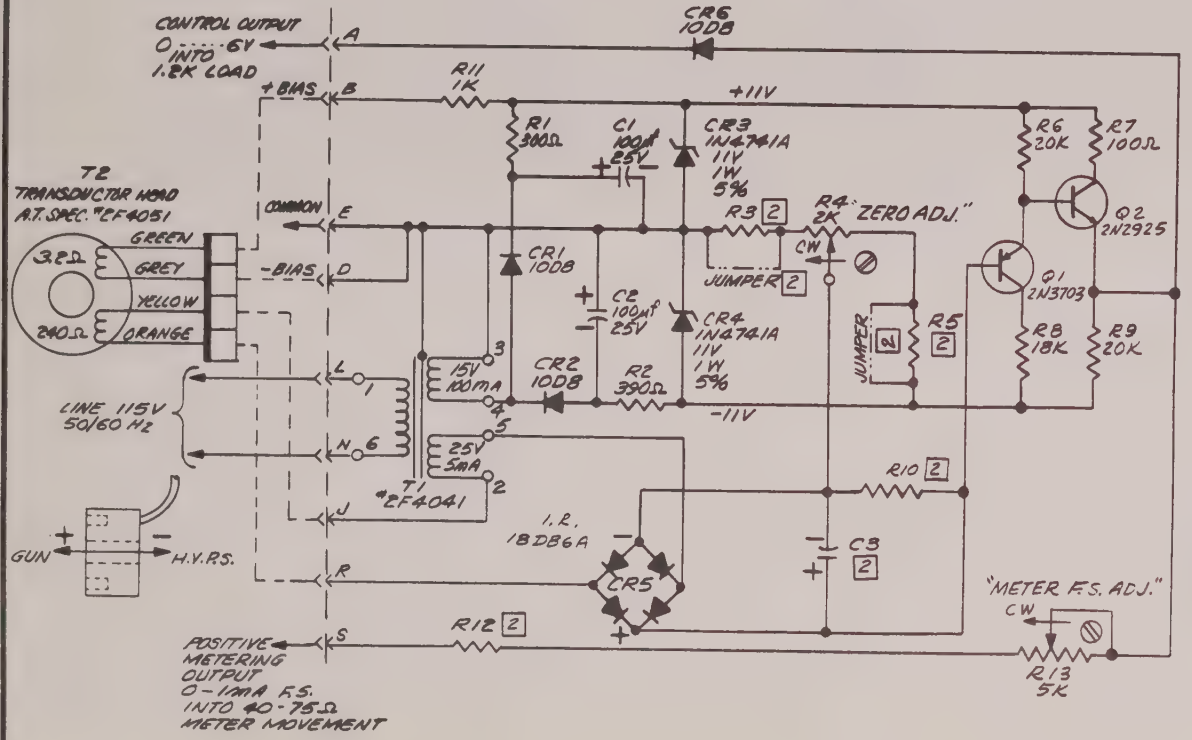
307-1304 B

0101-8251-1

ITEM NO.	DWG.	MAT'L	QTY.

DASH NO. TABULATION

DASH NO.	AMPLIFIER RANGE	R3	R5	R10	R12	C3	USED ON MODEL NO.	USED ON SCHEMATIC	REF FINAL A.C. BOARD ASSY	REF BASIC A.C. BD ASSY 90% COMP.
0	1.2A	2K	JUMPER	12K	3K	.47μf 200V	ES6-210	306-3135	307-1304-0	307-1293 [3]
1	1.2A	2K	JUMPER	12K	3K	1.0μf 50V	EGC-1, EGC-1A, EGC-1.2.3	35-7183, 306-4178-2K, 37-2078-2K	-1	
2	3.0A	JUMPER	2K	5.1K	3K	1.0μf 50V	EGC-426	EF-3954-2, 4	-2	
3	5.0A	JUMPER	2K	3K	3K	1.0μf 50V	SPECIAL	EF-3954-5	-3	
4	10.0A	JUMPER	2K	1.5K	3K	1.0μf 50V	SPECIAL		-4	
5	15.0A	JUMPER	2K	1.0K	3K	1.0μf 50V	SPECIAL	306-6764, 306-6774	-5	
6	1.5A	2K	JUMPER	12K	5.1K	.47μf 200V	CV14/8	407-1655 SECTION ES10	307-1304-6	307-1293 [3]



NOTES:
UNLESS OTHERWISE SPECIFIED

1. RESISTORS ARE 1/2 W, ±5% COMP CARB
2. [2] SEE TABULATION FOR VALUE AND/OR USE
3. [3] FOR BASIC P.C. BOARD ASSY 90% COMPLETE OMIT COMPONENTS R3, 5, 10, 12 & C3
4. [4] FOR USED ON & FINAL P.C. BD ASSY DWG. NO. SEE TABULATION

REV.	DESCRIPTION	BY	DATE	APP'D
D	I.R. 18DBGA WAS MP01188D	K.O.B.	8-17-72	JG
C	REDRAWN WITH CHANGES	EJM	12227	JG

DO NOT SCALE DRAWING
UNLESS OTHERWISE SPECIFIED

FINISH | TOLERANCE: XXX ± .005, XX ± .01, X ± .03 | DECIMAL-BASIC | DECIMAL-EQUIVALENTS | USED ON DWG. [4]

BERKELEY ARCO Temescal CALIFORNIA
A DIVISION OF AIR REDUCTION COMPANY, INCORPORATED

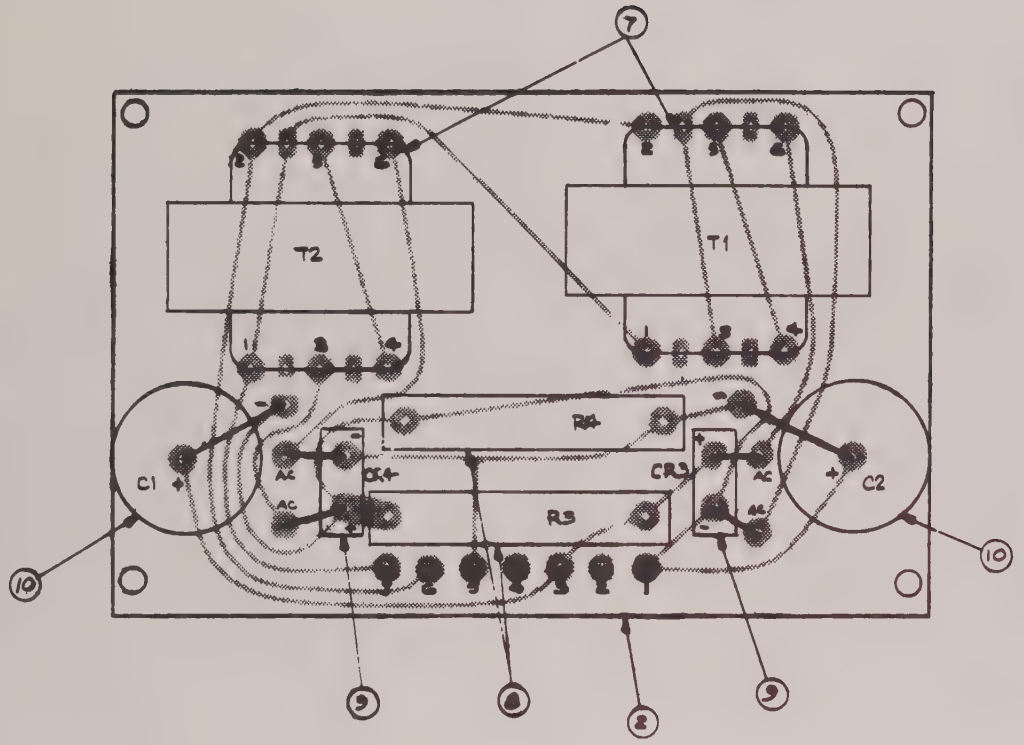
DRAWN BY	DATE	CHK BY	APP BY	SCALE
S.E. ROMERO	8 1 1970	RJA	DEO	NONE

A-T STANDARD
1.2A THRU 15A TRANSDUCTOR AMPLIFIER SCHEMATIC

DRAWING NUMBER: SPECIAL | SIZE D | REV. | 3074933

7-11-75

PRINTED ON DIPPO NO. 1030 CLEARPRINT



NOTES:
1. REF. DWGS : SCHEMATIC : 408-0304, 408-2464 (CV-8)
ARTWORK : 408-1923
FABRICATION : 408-1933

REV.	DESCRIPTION	BY	DATE	APPVD
	DO NOT SCALE DRAWING UNLESS OTHERWISE SPECIFIED			

FINISH ✓ TOLERANCE XXX ± .XXX ± .XX ± .X ± INTER. DASH BREAK ALL EDGES

USED ON DWG. 408-0320

BERKELEY AIRCO Temescal CALIFORNIA
A DIVISION OF AIRCO, INCORPORATED

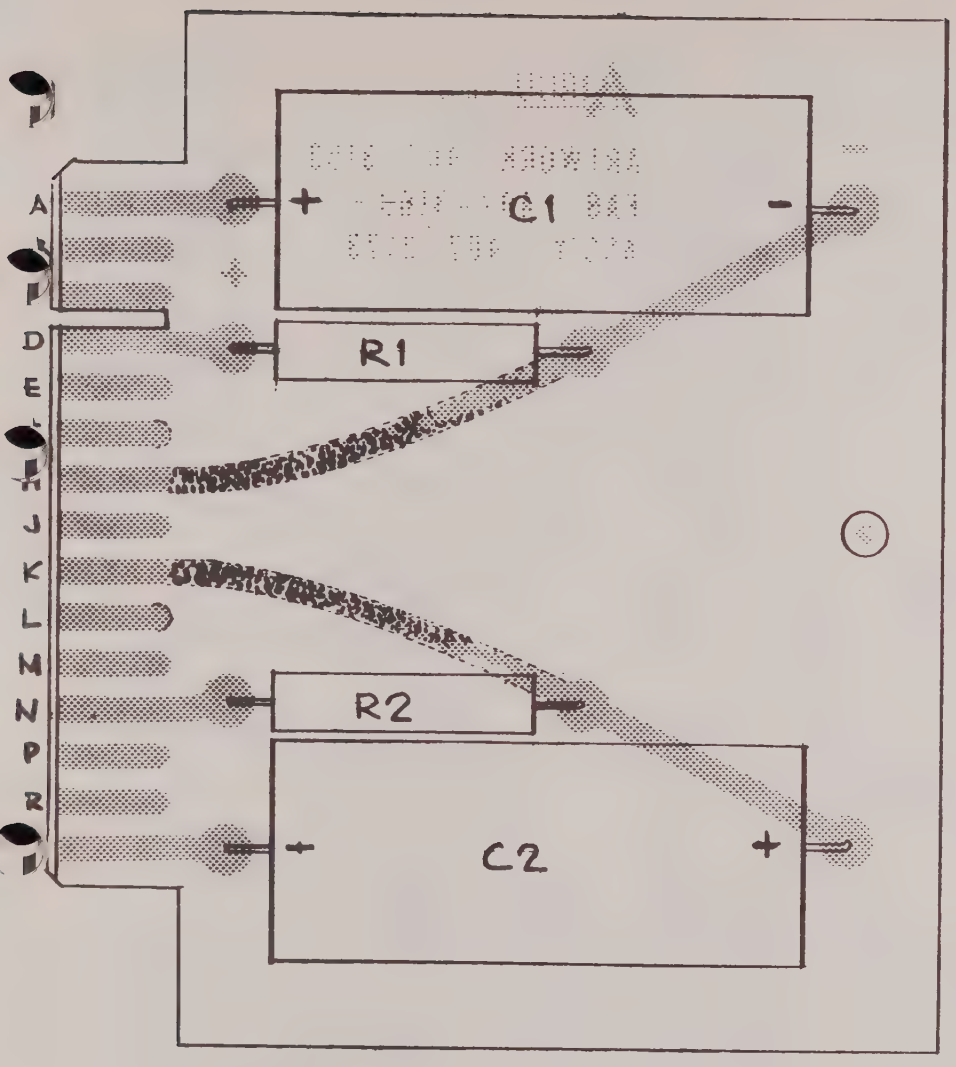
DRAWN BY S.L. GAMBLE DATE 12/1/72 CHK BY E.Y. APP BY E.Y. SCALE 8=1

A-T SWD CV-14/CV-8 KYS OPTION

DRAWER NUMBER: SERIAL — REV.

SWEEP CONTROL AUXILIARY POWER SUPPLY P.C. COMPONENT BOARD ASSEMBLY 408-1943

12-13-76



REV.	DESCRIPTION	BY	DATE	APP'VD
	DO NOT SCALE DRAWING			
	UNLESS OTHERWISE SPECIFIED			

FINISH √ | TOLERANCE .XXX ± .XX ± .X ± | BREAK ALL EDGES | USED ON DWG.

BERKELEY AIRCO Temescal CALIFORNIA
A DIVISION OF AIR REDUCTION COMPANY, INCORPORATED

DRAWN BY	DATE	CHK BY	APP BY	SCALE
F. GAMBLE	4/29/71	V.I.B.	E.Y.	2:1

CV-14/8 POWER SUPPLY

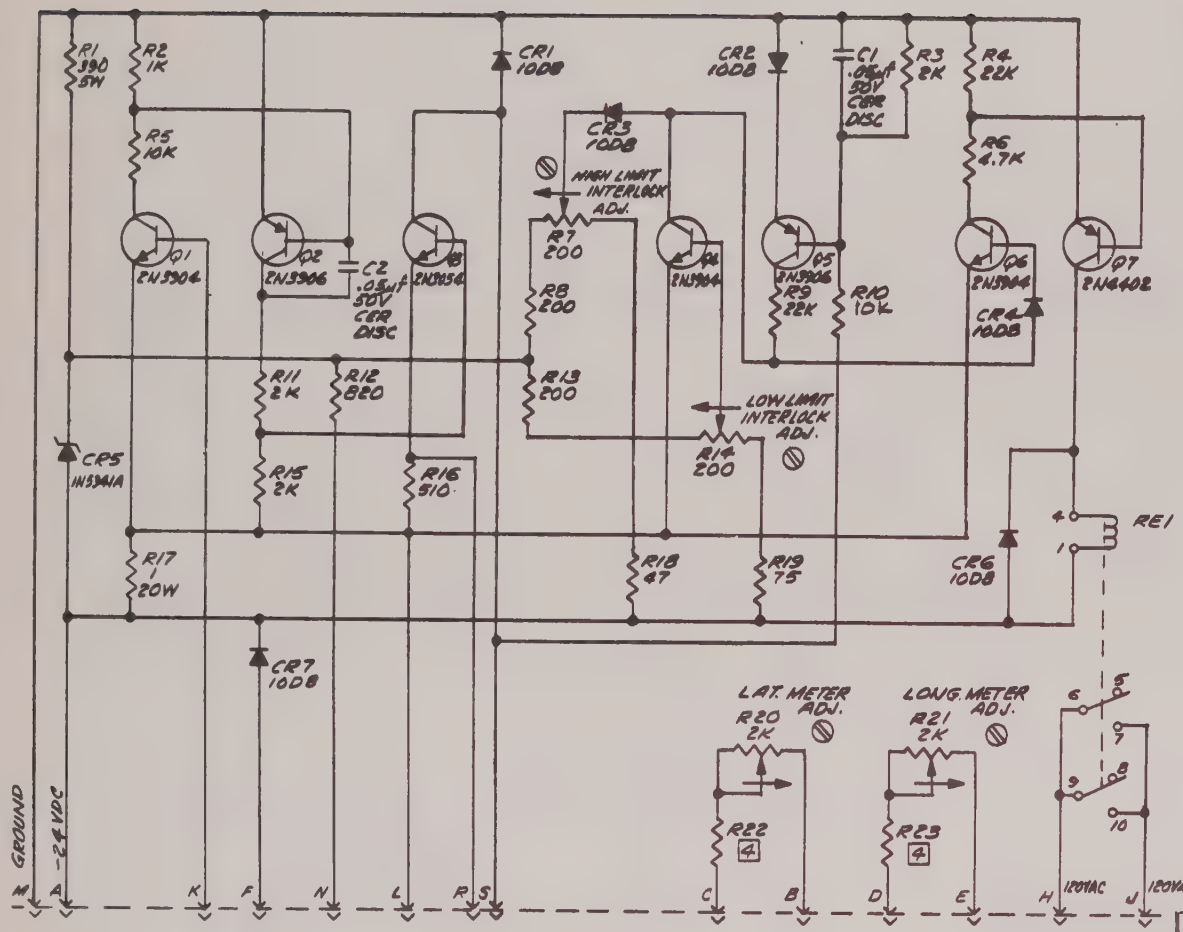
LATERAL SWEEP POWER SUPPLY PC. BOARD ASSEMBLY (SECTION 1111)

DRAWING NUMBER: 407-3173 | SIZE | REV

0101-8251-1

12-13-76

TABULATION BLOCK					
DASH NO.	VALUE R17	R22	R23	USED ON	ASSY PART
-1	AS SHOWN	2K	2K	CV-14	407-3873-1
-2	AS SHOWN	4.7K	4.7K	CV-8	407-3873-2
-3	REMOVE	NOT USED	2.7K	SPECIAL SYSTEM	407-3873-3



NOTES:
UNLESS OTHERWISE SPECIFIED

1 RESISTORS ARE ½W ±5% CARB. COMP
2 RESISTOR VALUES ARE IN OHMS
3 REF. DWG. NOS.
ASSY 407-3873
FAB 407-3883
ART 407-3893
4 FOR VALUE SEE TABULATION BLOCK

REV.	DESCRIPTION	BY	DATE	APPVD
C	ADDED -3 OPTION & R17 CALLOUT	FG	7/14/75	RB
B	ADDED NOTE # 2 TABULATION BLOCK	EM	4-4-72	EJ
A	Z10 WAS 4.7K	FG	1-3-72	EJ

DO NOT SCALE DRAWING
UNLESS OTHERWISE SPECIFIED

FINISH | TOLERANCE XXX ± — AND ± XX ± — ± | USED ON DWG. 407-4015

BERKELEY AIRCO Temescal CALIFORNIA
A DIVISION OF AIR REDUCTION COMPANY, INCORPORATED

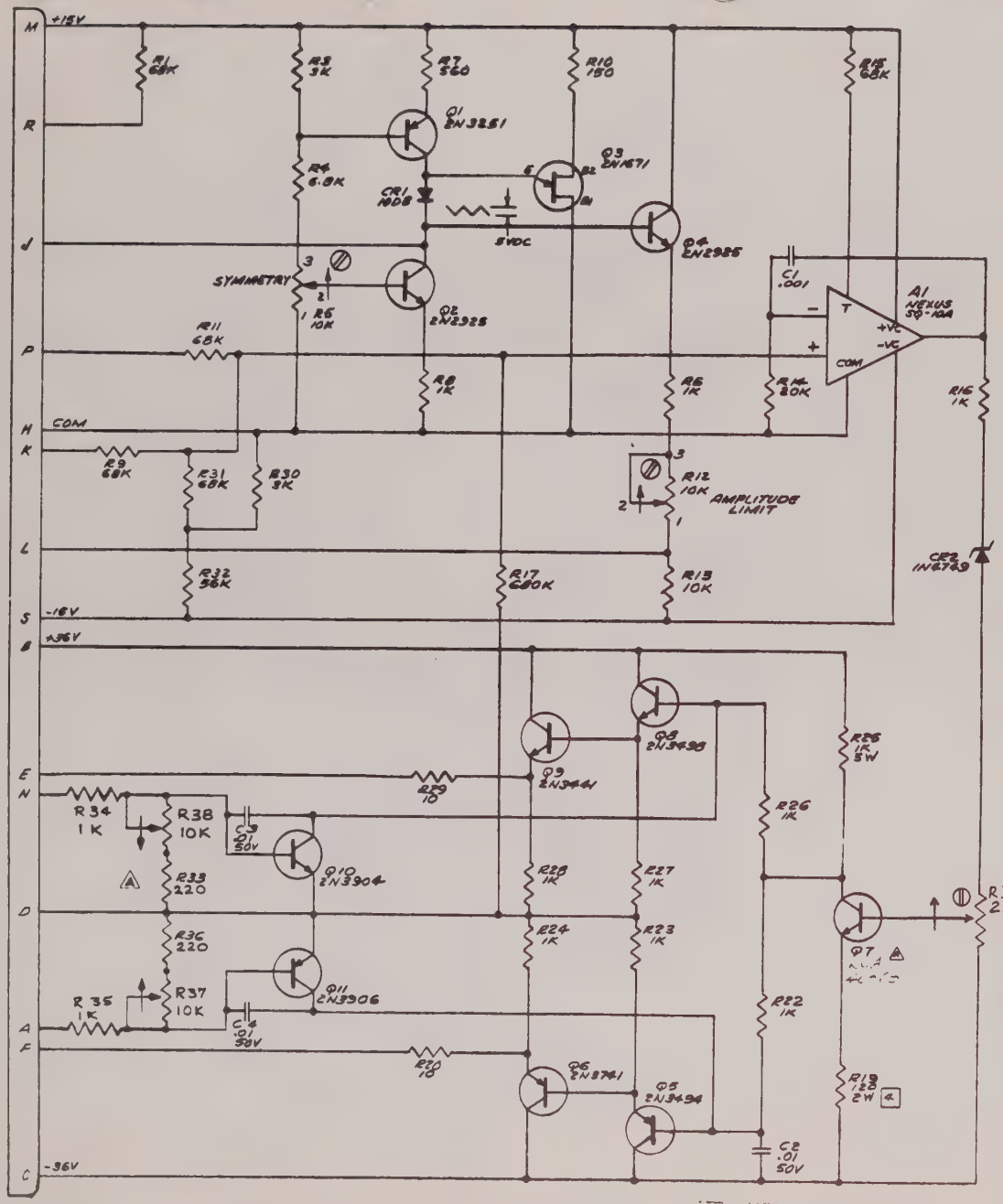
DRAWN BY E. Martin DATE 5/20/71 CHK BY V.C.B APP BY E.J. SCALE NONE

AT STANDARD CH14/B
LONGITUDINAL FOCUS P.C. BOARD
SCHEMATIC SEC. 2611

DRAWING NUMBER 407 3863 C

7-10-75

PRINTED ON DIEPO NO. 1030 CLEARPRINT



NOTES:
UNLESS OTHERWISE SPECIFIED

1. ALL RESISTORS (Ω) ARE ½ W, ±5% CARB COMP
2. ALL RESISTANCE SHOWN IN OHMS
3. ALL CAPACITOR VALUES IN MICROFARADS
4. R19 ALTERNATE VALUE FOR BALANCING 100 Ω 2W RESISTOR
5. REFERENCE DRAWINGS:
   ARTWORK 409-4542
   FABRICATION 409-4555
   ASSEMBLY 409-4563

REV.	DESCRIPTION	BY	DATE	APP'D
C	DELETED R21(470Ω) R18(1K) Add R39 DCN 0989	JH	5/13/74	JH
B	DELETED R5; R3 WAS 2K; R21 WAS 1K	FG	1/8/74	
A	ADD NOTE 2 ST 5B PUT R39 / R5 IN SERIES WITH R3 / R8 R33 AND R36 WERE 3K	Z	9-18-73	

DO NOT SCALE DRAWING
UNLESS OTHERWISE SPECIFIED

FINISH | TOLERANCE XXX ± ANG ± XX ± X ± | UNTIL BADLY | BREAK ALL EDGES | USED ON DWG.

BERKELEY AIRCO Temescal CALIFORNIA
A DIVISION OF AIR REDUCTION COMPANY, INCORPORATED

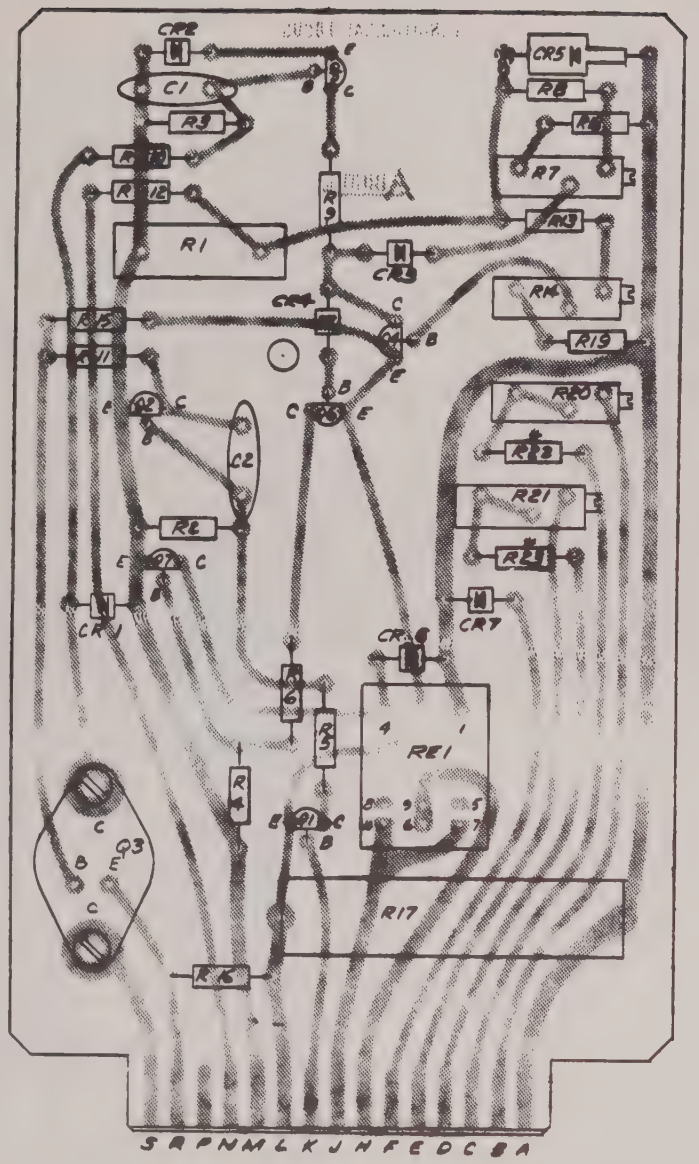
DRAWN BY GAMBLE 5 9 75 | CHK BY | APP BY | SCALE NONE

A-T STANDARD CV14/8

LONG. & LAT. SWEEP P.C. BOARD (SERIES) SCHEMATIC (SECTION 2612 & 2613)

DRAWING NUMBER 409-4533 C

7-10-75



HI LIMIT INTLK ADJ.

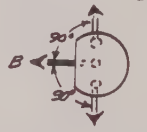
LOW LIMIT INTLK ADJ.

LATERAL METER ADJ.

LONG. METER ADJ.

NOTES:
UNLESS OTHERWISE SPECIFIED

1 TRANSISTORS (EXCEPT Q3)
BEND BASE LEAD TOWARD FLAT SIDE
BEND C & E LEADS 90° FROM BASE



2 REFERENCE DRAWINGS:
SCHEMATIC 407-3863
FABRICATION 407-3883
ARTWORK 407-3893

* 3 DASH 1 FOR CV-14 } SEE SCHEMATIC FOR VALUE CHANGE 407-3863
DASH 2 FOR CV-18 }

REV.	DESCRIPTION	BY	DATE	APPVD
A	ADDED DASH NUMBERS	VCB	7-20-71	

DO NOT SCALE DRAWING
UNLESS OTHERWISE SPECIFIED

FINISH | TOLERANCE XXX ± — ANG ± — XX ± — ± — | INTER. RADII BREAK ALL EDGES | USED ON DWG.

BERKELEY AIRCO Temescal CALIFORNIA
A DIVISION OF AIR REDUCTION COMPANY, INCORPORATED

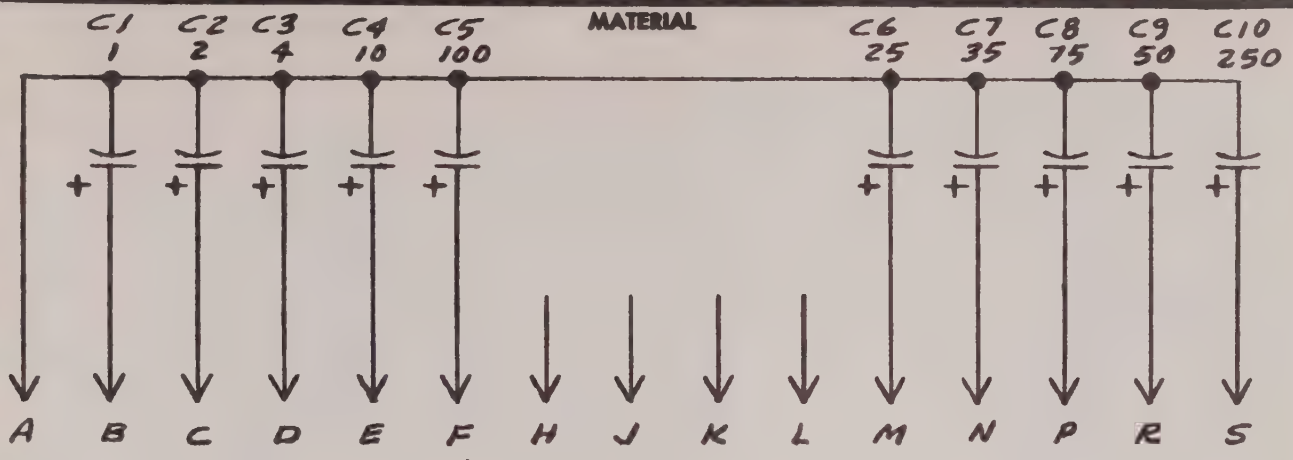
DRAWN BY	DATE	CHK BY	APP BY	SCALE
E. Mathews	5 28 71	VCB	E.Y.	2/1

A-T STANDARD CV-14/18
LONGITUDINAL FOCUS P.C. BOARD ASSEMBLY SEC 2611

DRAWING NUMBER: 407 3873 A

7-10-75

PRINTED ON DIEPO NO 1000 CLEARPRINT



NOTES:

1. CAPACITORS ARE IN MFD, 50VOLT
2. REF. DWGS:
   ASSEMBLY 407-3983
   FABRICATION 407-3993
   ARTWORK 407-4003

REV.	DESCRIPTION	BY	DATE	APP'VD
A	REDRAWN - O.M.	VCB	4-6-76	VG

DO NOT SCALE DRAWING
UNLESS OTHERWISE SPECIFIED

FINISH √ | TOLERANCE XXX ± ANG ± XX ± X ± | INTER. RADII | BREAK ALL EDGES | USED ON DWG. CV-14 408-0304 CV-8 408-2464

BERKELEY AIRCO Temescal CALIFORNIA
A DIVISION OF AIR REDUCTION COMPANY, INCORPORATED

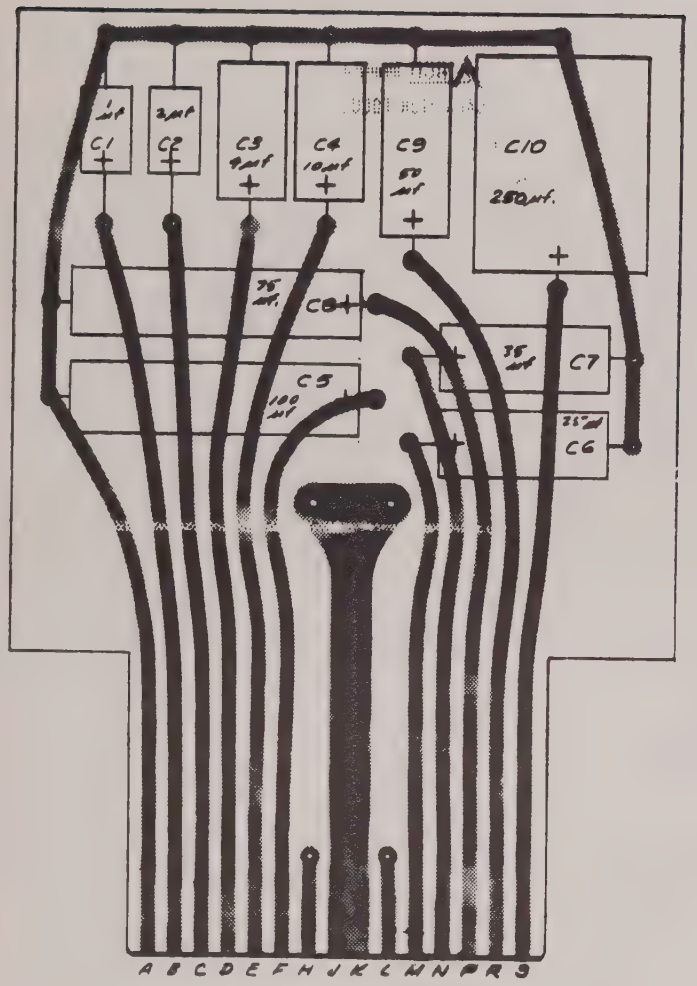
DRAWN BY	DATE	CHK BY	APP BY	SCALE
K. BURGETT	4/6/76		VG	NL

A-T STANDARD CV-14/8 CONTROL
CONSOLE - CAPACITOR FOCUS P.C.
BOARD - SCHEMATIC

DRAWING NUMBER: SERIAL 407-3971 SIZE A REV

ENG. REF 505-7661

WARNING: MICRO FILM CONFORMS



NOTES:
UNLESS OTHERWISE SPECIFIED

REFERANCE DRAWINGS
SCHEMATIC 407-3971
FABRICATION 407-3993
ARTWORK 407-4003

REV.	DESCRIPTION	BY	DATE	APPVD
A	REMOVED R1 & R2	Z	10-3-73	JA

DO NOT SCALE DRAWING
UNLESS OTHERWISE SPECIFIED

FINISH | TOLERANCE: XXX ± — AND ± — ; XX ± — X ± — | INTERP. RADII | BREAK ALL EDGES | USED ON DWG.

BERKELEY AIRCO Temescal CALIFORNIA
A DIVISION OF AIR REDUCTION COMPANY, INCORPORATED

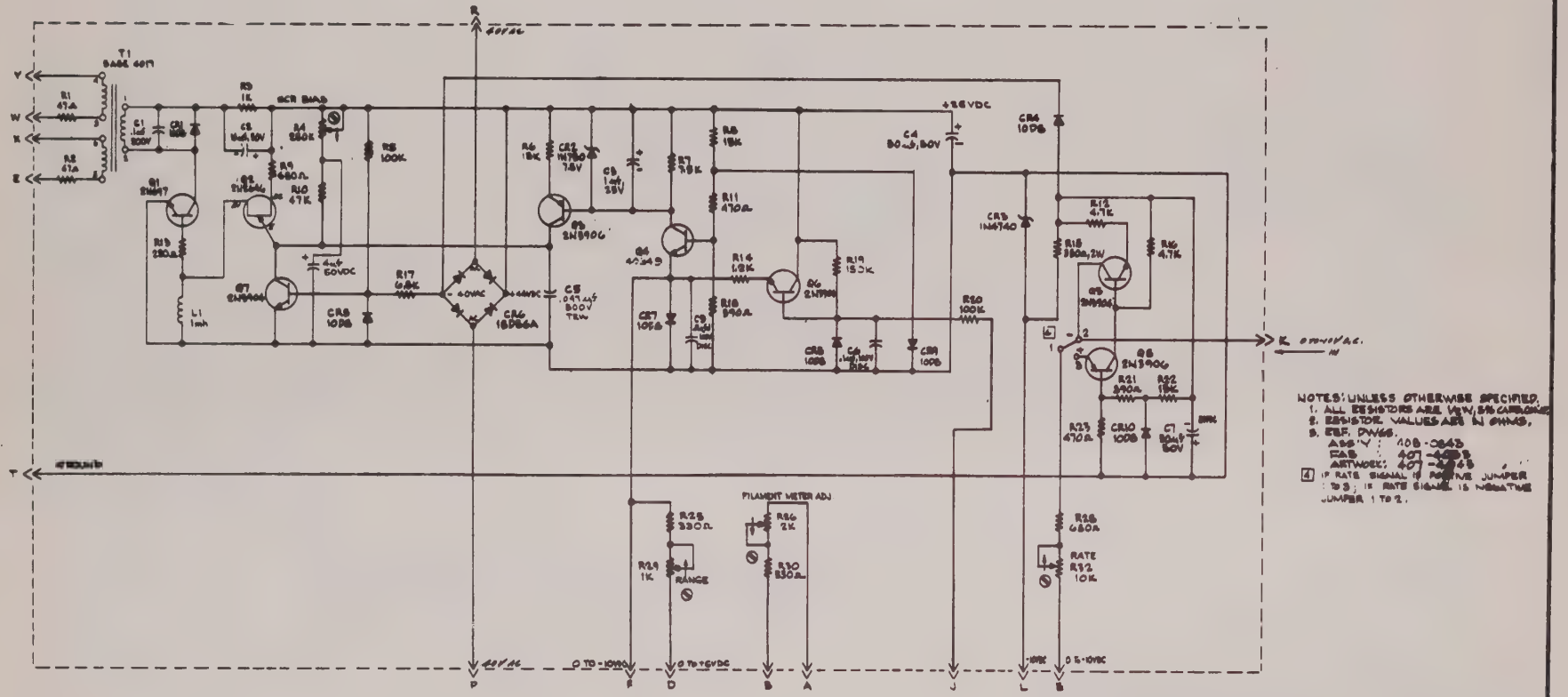
DRAWN BY	DATE	CHK BY	APP BY	SCALE
E. Mateu	6/2/71	VCB	E.Y.	2/1

A-T STANDARD CV-4A CONTROL CONSOLE
CAPACITOR FOCUS P.C. BOARD ASSEMBLY (SECTION 2GA2 2G1B)

DRAWING NUMBER: 407 3983 A

7-10-75, [illegible]

PRINTED ON DIAZO NO. 1022 CLEARPRINT



B	REVERSED POLARITY OF C2 "ERN J" WAS "C"	TC	6/7/74
A	ORIGINAL RELEASE	PR	6/4/74
REV	DESCRIPTION	BY	DATE

DO NOT SCALE DRAWING
UNLESS OTHERWISE SPECIFIED

AIRCO Instrol
BERKELEY CALIFORNIA
A DIVISION OF AIR REDUCTION COMPANY, INCORPORATED

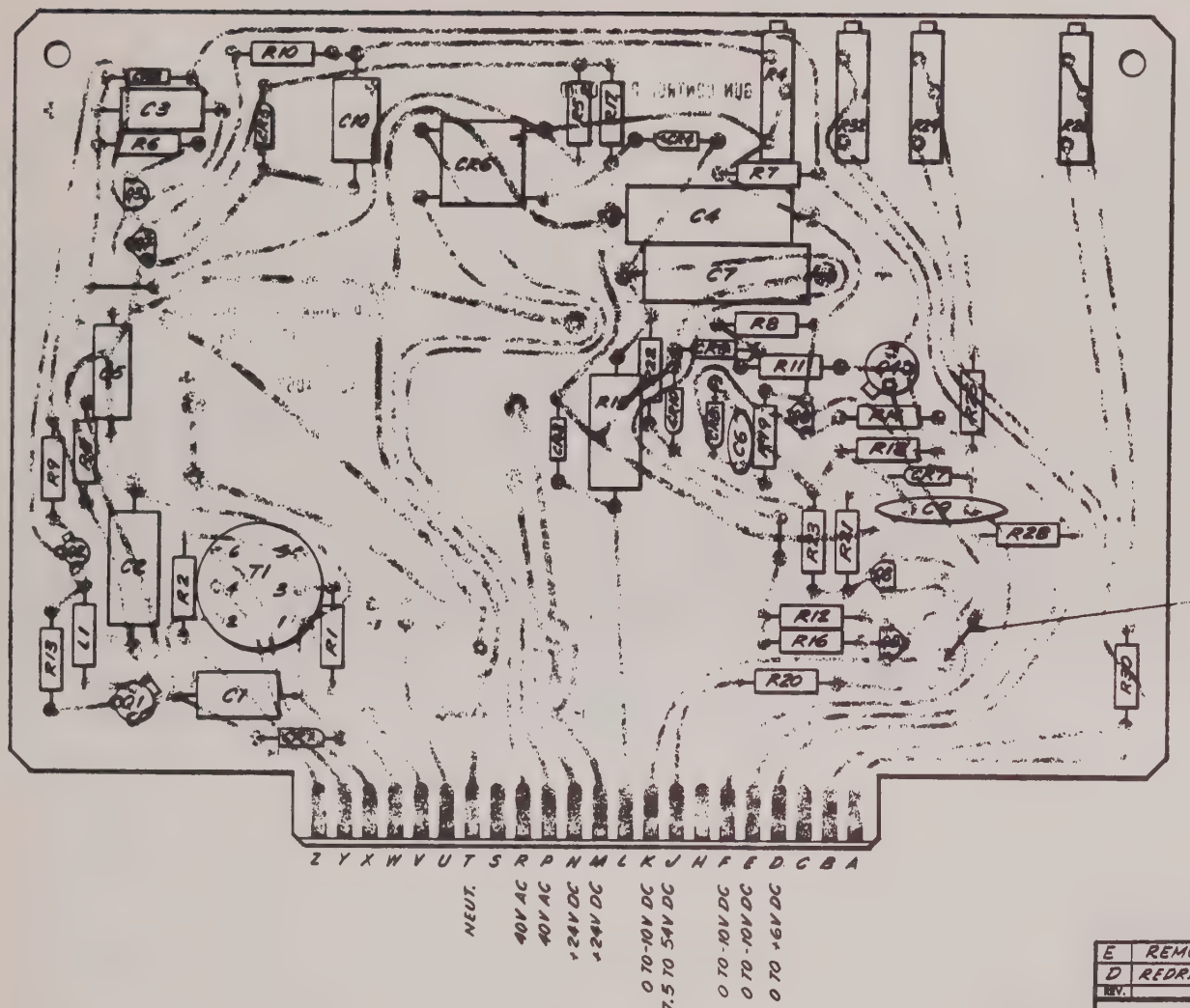
DRAWN P. GAMB | CHKD [illegible] | ENGR [illegible] | APPD [illegible]

GUN CON[illegible] P.C. CARD SCHEMATIC

408-083[illegible]

XEON PREMIUM

0101-8251-1



NOTES:

1. REF. DWGS.:
   SCHEMATIC 408-0834
   ARTWORK 407-4043
   FABRICATION 407-4053

22 BARE WIRE STRAP (3) PLACES

REV.	DESCRIPTION	BY	DATE	APPVD
E	REMOVED (2) MTG. HOLES	[illegible]	5/26/76	
D	REDRAWN TO MATCH ARTWORK CHANGE	JS	5-14-75	

DO NOT SCALE DRAWING
UNLESS OTHERWISE SPECIFIED

FINISH √ | TOLERANCE XXX ± ANG ± XX ± X ± | INTER. EACH | BREAK ALL EDGES | USED ON DWG.

BERKELEY AIRCO Temescal CALIFORNIA
A DIVISION OF AIR REDUCTION COMPANY, INCORPORATED

DRAWN BY	DATE	CHK BY	APP BY	SCALE
F. GAMBLE	6/14/71	VCB	EY	2:1

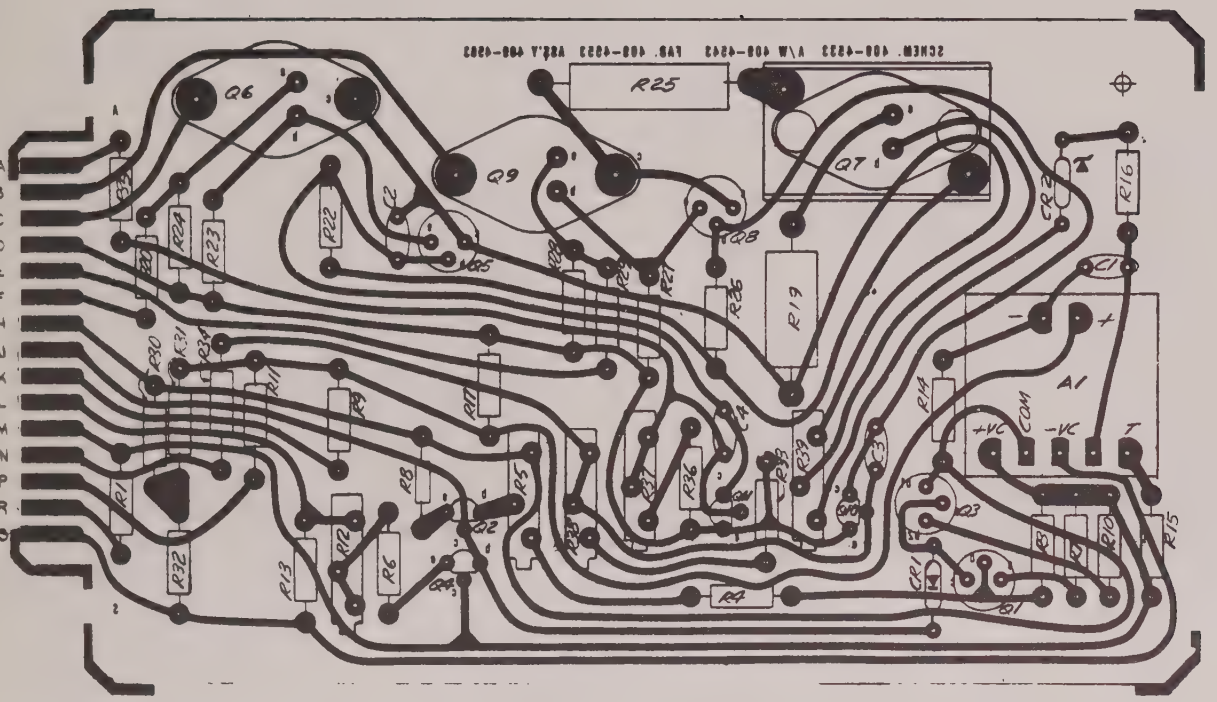
CV-8 POWER SUPPLY

GUN CONTROL P.C. CARD ASSEMBLY

DRAWING NUMBER: SERIAL 408-0843 SIZE E REV

12 13-76

PRINTED ON DIEPO NO. 1030 CLEARPRINT



NOTES:

1. REF. DWGS:
   SCHEM. -409-4533C
   A/W 409-4543E
   FAB. 409-4553F

COMPONENT SIDE

REV.	DESCRIPTION	BY	DATE	APP'D
E	REVISED & REDRAWN	D.G.	[illegible]	[illegible]
D	REMOVED R21/18 ADDED R39 (POT) D.C.N. #0487	V.E.B.	6-11-76	U.W.
C	REVISED PER M.U.	D.G.	[illegible]	[illegible]
B	REVISED & REDRAWN	R.E.W.	10-29-75	[illegible]

DO NOT SCALE DRAWING
UNLESS OTHERWISE SPECIFIED

FINISH: √ | TOLERANCE: XXX ± .015 AND ± 1° ; XX ± — ; X ± — | INTERP. RADII: MIN. | BREAK ALL EDGES: AS REQ'D | USED ON ENGR.: 409-4563

BERKELEY AIRCO Temescal CALIFORNIA
A DIVISION OF AIRCO, INCORPORATED

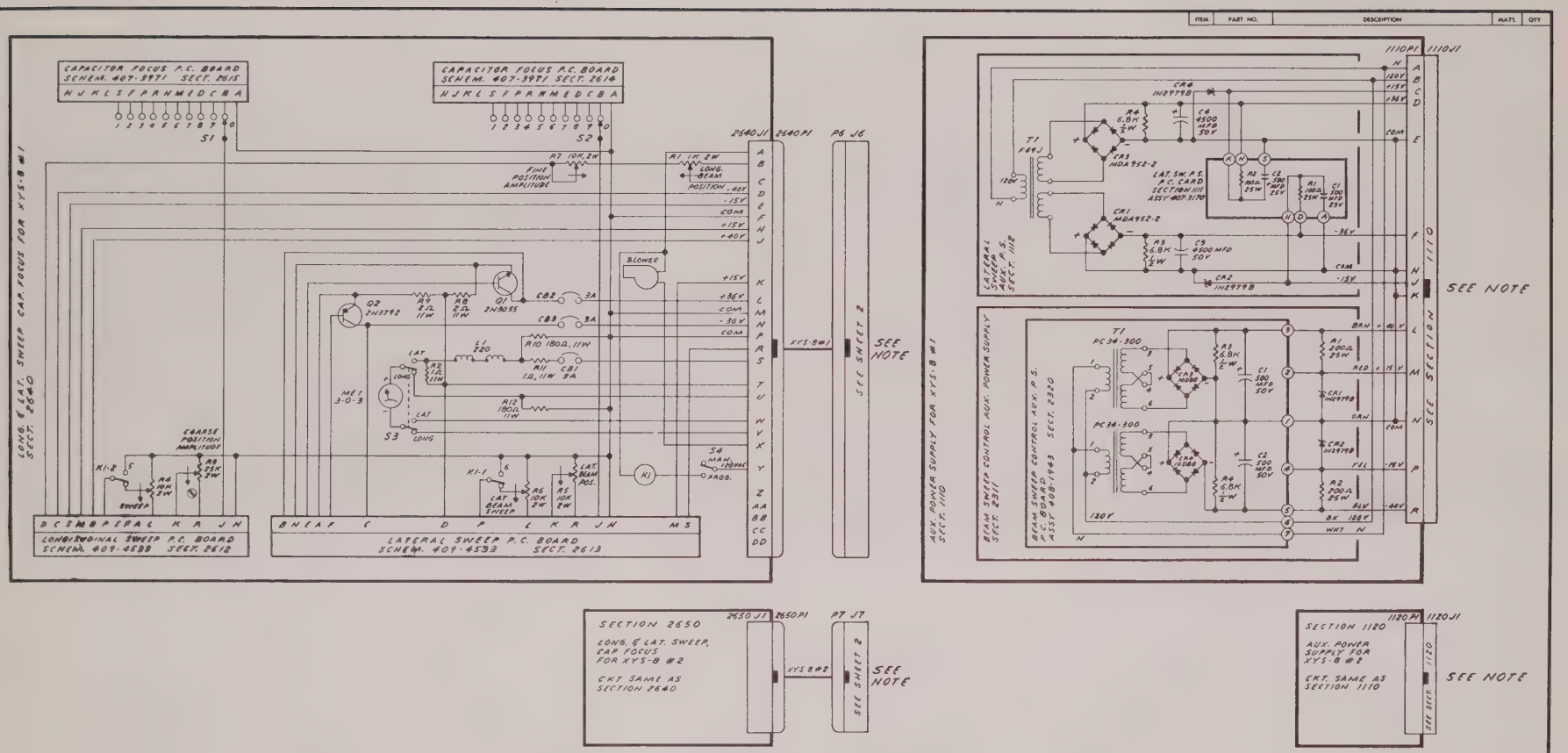
DRAWN BY R.E. WALKER | DATE 10/25/73 | CHK BY VCB | APP BY TA | SCALE 2:1

A.T. STD CV14/8

LONG. & LAT. SWEEP P.C. BOARD ASSEMBLY (SERIES)

DRAWING NUMBER: INITIAL [illegible] | REV [illegible] | 409-4563 | [illegible]

7-10-75


CAPACITOR FOCUS P.C. BOARD SCHEM. 407-3971 SECT. 2615
CAPACITOR FOCUS P.C. BOARD SCHEM. 407-3971 SECT. 2614
LONG. & LAT. SWEEP CAP FOCUS FOR XYS-8 #1 SECT. 2640
2640J1 2640P1 P6 J6
XYS-8#1
SEE NOTE
SEE SHEET 2
LONGITUDINAL SWEEP P.C. BOARD SCHEM. 409-4588 SECT. 2612
LATERAL SWEEP P.C. BOARD SCHEM. 409-4533 SECT. 2613
BLOWER
AUX. POWER SUPPLY FOR XYS-8 #1 SECT. 1110
1110P1 1110J1
LATERAL SWEEP AUX. P.S. SECT. 1112
BEAM SWEEP CONTROL AUX. POWER SUPPLY SECT. 2311
BEAM SWEEP CONTROL AUX. P.S. P.C. BOARD ASSY 408-9943 SECT. 2320
SECTION 1110
SECTION 2650
LONG. & LAT. SWEEP, CAP FOCUS FOR XYS-8 #2
CKT. SAME AS SECTION 2640
2650J1 2650P1 P7 J7
XYS-8#2
SECTION 1120
AUX. POWER SUPPLY FOR XYS-8 #2
CKT. SAME AS SECTION 1110
1120P1 1120J1

NOTE:

VOLTAGE	CV14 SCHEMATIC		
	A-T DWG.	SHEET 1	SHEET 2
208/220/240	506-0365	POWER MODULE (SECT. 1110, 1120)	CONTROL CONSOLE
360/380/415	506-0445		

DASH NUMBER TABULATION		
DRAWING NUMBER	USES SECTION NUMBER	FOR
506-1604-1	1110 AND 2610	XYS-8 #1
506-1604-2	1110, 1120, 2610 AND 2620	XYS-8 #2

REV	DESCRIPTION	BY	DATE	APVD
B	REVISED PER DCN #0591	JS	10-1-79	
A	SCHEM CHANGE PER DCN 0706	WE	8-4-77	

DO NOT SCALE DRAWING
UNLESS OTHERWISE SPECIFIED

BERKELEY ARCO Temescal CALIFORNIA
A DIVISION OF AIR REDUCTION COMPANY, INCORPORATED

DRAWN JW & STEPHENS | CHK | APVD | SCALE NONE

CV-8 OPTIONS FOR A-T STD.

XYS-8 SWEEPER POWER SUPPLY SCHEMATIC

ENGR REF 408-2664B

506-1604 4 B

WARNING ARC-FLASH CHANGE CONTROL 12/8/79

ENGR. REF. 505-6125 B

SCHEMATIC

POWER MODULE ECONTROL CONSOLE 506-036 5 C

C V-8 A-T-STANDARD 160 220 240V

Bille Huff Ltr. PD Audf

Allen-Bradley — A DIVISION OF AIR REDUCTION COMPANY INCORPORATED — CALIFORNIA

DO NOT SCALE DRAWING — UNLESS OTHERWISE SPECIFIED

REV	DESCRIPTION	BY	DATE	APVD
A	SCHEMATIC CHANGE PER DCN 0766	WE	8-17	PD
B	REDRAWN-ORIGINAL TOWN	MWT	1/4/77	PD
C	CHANGE #1 PAGE PER # 0749	LAB	1-25-77	

926-036 5

NOTES:
UNLESS OTHERWISE SPECIFIED
1. SHEET 1 of 2 : POWER MODULE SHEET 2 of 2 : CONTROL CONSOLE
2. POWER MODULE REFERENCE DESIGNATIONS PREFIXED WITH SECTION NUMBER IE: 400 K3 CONTROL CONSOLE HAS NO PREFIX FOR REF DESIGNATIONS

SECTION 900 BIAS SUPPLY

SECTION 910 BIAS SUPPLY R.C. CARD

SECTION 1120 P52 SAME CKT AS SECT. 1110

SECTION 1101 P5#1 LONG FOCUS AND GUN CONTROL

SECTION 1110 (OPTIONAL) AUX POWER SUPPLY SAME CKT AS SECT. 1110

SECTION 1111 (OPTIONAL) AUX POWER SUPPLY SEE SCHEMATIC 506-1404

SECTION 1111 LATERAL SWEEP PC

SECTION 231 BEAM SWEEP CONTROL

SECTION 1000 REGULATOR R.C. CARD 305-7684 ASSY. MODIFIED

SECTION 610 H.V. RECT. RC. CARD

SECTION 600 H.V. RECT. PANEL

SECTION 620

SECTION 700 TRIODE PANEL

SECTION 500 H.V. TRANSFORMER T1 207-6353

SECTION 400 STEP START PANEL

SECTION 200 MAIN POWER CIRCUIT BRKR.

SECTION 1400

SECTION 300 CONTROL TRANSFORMER

POWER INPUT: 208, 220, 240 VOLTS 3 ϕ 50/60 Hz. 50 AMPS 4 WIRE ϕ GROUND

CHANNEL #1

CHANNEL #2

CONTROL

CENTRAL GROUND POINT

TANK

506-0365 1/2

MF

ITEM	PART NO.	DESCRIPTION	MAT'L	QTY

CHANNEL #1
SEE J40 SHEET 1

RATE INPUT #1
0 TO +OR- 10V DC

XYS-8 #1
(OPTIONAL)
A-T 506-1604
SECTION #2640

CONTROL
SEE J30 SHEET 1

J2 J4 J6 J1

0 TO 120V AC
CB7 5A
AUXILARY
LT7
R3 1Ω, 25W
R7 1Ω, 25W
CR1 1BDB6A
#16
HEATSINK
.047 mfd 200V
C3
C1 1 mfd
CR2 2N1847
R4 10Ω 2W
CR3 2N1847
C2 .047 mfd 200V
HEATSINK
#16
RE3-1
120V AC
LT8
GUN WATER
SW3
R5 3K, ½W
R6 1K
EMISSION CURRENT
0 TO -10V DC
LT9
FOCUS
RE3-3
RE3-2
PB3 FIL OFF
PB4 FIL ON
SW4
FIL
EMISSION
ME2 0-1.5A
EMISSION/FIL
SW8A
NORM
SW8
R8 10Ω, 50W
CB8 3A
L1 220
0 TO -24V DC
R9 1Ω, 25W
Q1 2N3055
HEATSINK
XYS-8
SW8B
SW8C
R10 1K
BEAM POSITION
PC2 J1
PC2 LONG FOCUS P.C. CARD SCHEMATIC 407-3863
CONTROL CB1 15A
RE1-1
RE1-2
#14
#16
CB3 10A
V1 FILAMENT & FAN
CB4 5A
BIAS 300 & XYS-8-1
EGC-1 CB5 5A
EGC-2 CB6 5A
CONTROL & XYS-8-2 CB2 5A
#16
120V AC
ME1 0-15KV
R1 100Ω
VOLTAGE ADJ.
RE1-3
KEYLOCK
SW1
LT1 POWER ON
LT2 AIR
RE1-3
LT3 DOORS
LT4 VAC. TANK
LT5 VAC GAUGE
LT6 PC CARD & KEYLOCK
RE2-1
HV OFF PB1
HV ON PB2
TD2-1
TD1-1
CR11 IN3322B X2 CR12
R25 20Ω
TD1-2
TD1 2 SEC 2-0
RE2 1-0
RE5-1
R2 330K, ½W
PC1 GUN CONTROL P.C. CARD
SCHEMATIC 408-0834
ASSEMBLY 408-0843
PC1J1
PC3 TRANSDUCTOR P.C. CARD SCHEMATIC 307-4933-6
PC3J1
PC4 GUN CONTROL P.C. CARD
SCHEMATIC 408-0834
ASSEMBLY 408-0843
PC4J1
PC6 TRANSDUCTOR P.C. CARD SCHEMATIC 307-4933-6
PC6J1
PC5 LONG FOCUS P.C. CARD ASSEMBLY 407-3873
PC5J1
SW6
R13 3K, 1W
R14 1K
EMISSION CURRENT
LT12
FOCUS
FIL ON PB6
FIL OFF PB5
RE4-3
RE4-2
SW7
FIL
EMISSION/FIL
ME3 0-1.5A
EMISSION
NORM
SW9
SW9B
SW9C
R18 1K
BEAM POSITION
XYS-8
Q2 2N3055
HEATSINK
R17 1Ω, 25W
L2 220
CB10 3A
0 TO -24V DC
SW5
SW9A
R16 10Ω, 50W
RE4-1
LT11
GUN WATER
CR5 2N1847
C5 .047 mfd 200V
R12 10Ω 2W
C4 1 mfd 200V
CR6 2N1847
C6 .047 mfd 200V
HEATSINK
CR4 1BDB6A
R11 1Ω, 25W
R15 0 TO 20V AC
CB9 5A
AUXILARY
LT10
GROUND
-24V DC
0 TO -24V DC
XYS-8 I OR 2
120V AC
40V AC
HV ON SYNC
J3 J7 J5
CHANNEL #2
SEE J50 SHEET 1
RATE INPUT #2
0 TO +OR- 10V DC
XYS8 #2
(OPTIONAL)
A- -1604
#2650

506-0365

REV	DESCRIPTION	BY	DATE	APPVD
B	REDRAWN-ORIGINAL TOAN	HUFF	11-21-77	PD
A	SCHEMATIC CHANGE PER DCN 0706	WE	8-8-77	PD

DO NOT SCALE DRAWING
UNLESS OTHERWISE SPECIFIED

BERKELEY ARCO Electronics CALIFORNIA
A DIVISION OF AIR REDUCTION COMPANY, INCORPORATED

DRAWN BY	BILL HUFF 11/23/77	DATE	CHK BY	PD	SCALE NONE
CV-8 A-T STANDARD 208/220/240V					
POWER MODULE & CONTROL CONSOLE SCHEMATIC					506-0365 SHEET 2 OF 2 B

(CONTROL CONSOLE)

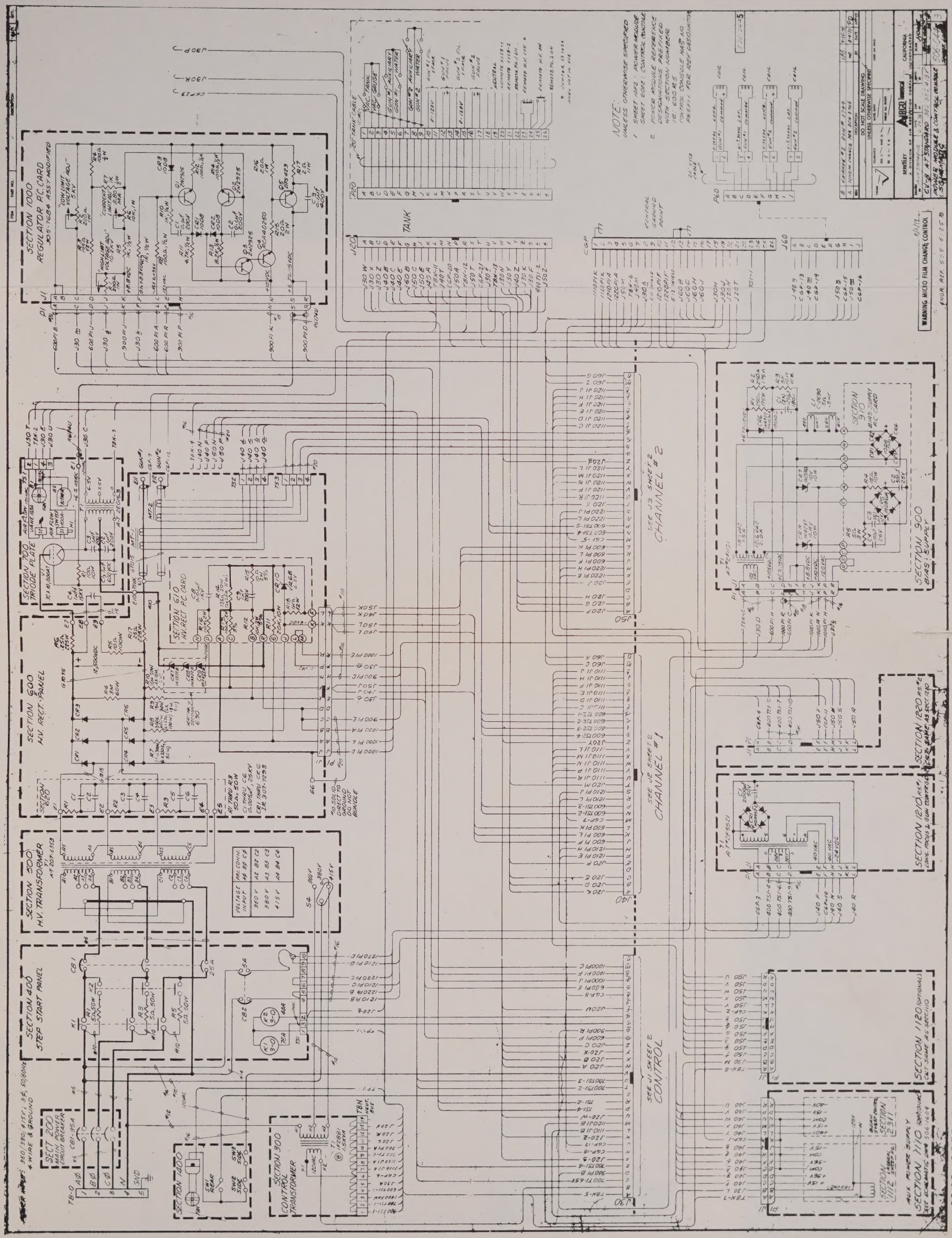
ENGR. REL 506-6125 B

WARNING ARCO FILM CHANGE CONTROL 11-23-77

506-0365

0101-8251-1

506-0445
sht 1 of 2



SEE J40 SHEET 1
CHANNEL #1

0 TO +OR-10VDC
RATE INPUT #1

A-T 506-1604
SECTION #2640
XYS-8 #1
OPTIONAL

SEE J30 SHEET 1
CONTROL

PC1 GUN CONTROL P.C. CARD
SCHEMATIC 408-0834
ASSEMBLY 408-0843

PC2 LONG FOCUS P.C. CARD
SCHEMATIC 407-3863

PC3 TRANSDUCTOR P.C. CARD
SCHEMATIC 307-4933-6

PC4 GUN CONTROL P.C. CARD
SCHEMATIC 408-0834
ASSEMBLY 408-0843

PC5 LONG FOCUS P.C. CARD
ASSEMBLY 407-3873

PC6 TRANSDUCTOR P.C. CARD
SCHEMATIC 307-4933-6

CHANNEL #2
SEE J50 SHEET 1

RATE INPUT #2
0 TO +OR-10VDC

OPTIONAL
XYS-8 #2
A-T 506-1604
SECTION #2650

REV.	DESCRIPTION	BY	DATE	APPD
4	SCHEMATIC CHANGE PER DCN 0766	WF	8-9-77	RD

DO NOT SCALE DRAWING
UNLESS OTHERWISE SPECIFIED

BERKELEY, CALIFORNIA

506-0445 SHT 2 OF 2

506-0445 B

MP MASTER
MA32751